The Journal

OF THE

BOARD OF AGRICULTURE

OF

BRITISH GUIANA.

... RESEARC
No
4 ... 191
... COIMBATORE

ISSUED QUARTERLY.

VOLUME VIII.

JULY, 1914—SEPTEMBER, 1915.

AGRICULTURAL COLLEGE AND RESEARCH INSTITUTE
No. 324
20 MAY 1936
COIMBATORE

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Demerara :

PRINTED BY "THE DAILY CHRONICLE," LTD., GEORGETOWN.

1915.

JOURNAL

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VOL. VIII. JULY AND OCTOBER, 1914. Nos. 1 & 2.

Visual Instruction.

It is impossible not to admire the striking way in which the Americans carry out new ideas. Theatrical their methods may be, but undoubtedly they show originality and enthusiasm. As an instance we may quote the Bureau of Health Exhibit at the Philippine Exposition of 1914. The exhibit was wholly educational in character and consisted of models, photographs, placards and cinematograph pictures. The last three of these are familiar enough, although often unaccountably neglected by the British; but the first seems to have been carried to the limit. "Huge models, having true proportion and colouring, were shown of flies, mosquitoes, bed bugs, cockroaches, fleas and disinfecting pumps. These models were also used in the Carnival parade accompanied by signs with appropriate catchy legends and rimes (*Anglicé* 'rhymes'). The disinfecting pumps were shown pursuing the insects." The models of the insects were approximately 6 ft. in length, and the pumps about 20 inches in diameter and 7½ ft. in height. The photographs of the display fully bear out these dimensions: and we read without surprise that "The exhibit attracted widespread attention and elicited much favourable comment both in the Carnival parade and in the Exposition." To the civilized eye the 'parade' may possibly have appeared as a mixture of a Masquerade and a travelling Circus: but we can imagine no better way of impressing the unsophisticated but susceptible mind of the native.

Yields of Varieties of Sugar-Cane: Crops of 1913.

By J. B. Harrison, C.M.G., M.A., Director, and C. K. Bancroft, M.A., F.L.S., Assistant Director, of Science and Agriculture.

THE yields of different varieties of sugar-cane cultivated in the colony in 1913 were as follows:—

Reports were received from 26 plantations as to their crops of Bourbon canes; on 25 of them the area under Bourbon exceeded 20 acres. The yields varied from 1.05 ton to 2.28 tons of sugar per acre, the mean yield being 1·70 ton of commercial sugar per acre.

Thirty-three plantations reported results with D 625; each having more than 20 acres of the variety. The lowest return per acre was 1.26 T* and the highest 2.35 T whilst the mean yield was 1.79 T.

Twenty-three plantations supplied returns from D 145; 22 of them having over 20 acres of this variety each. The extreme yields were .85 T. and 2.16 T., whilst the mean yield was 1.67 T.

Twenty-three estates supplied returns for B 208, the extremes being 1.00 and 2.80 T. whilst the mean was 1.70 T. Sixteen of the estates reaped more than 20 acres each of the variety, the extreme yield reported by them being 1.27 T. and and 2.80 T., whilst the mean worked out at 1.70 T.

D 109 was reaped on 16 plantations on areas of more than 20 acres each. The maximum yield recorded was 2.05 T. and the minimum .64 T, the mean of all being 1.53 T.

B 147 was returned from 9 estates, five of which had under cultivation more than 20 acres of it. The mean yield was 1.60 T. on all of the areas, the maximum being 2.66 T. and the minimum .89 T.

Green Transparent was reaped on 6 plantations, each having more than 20 acres of it. The extremes of the yields obtained were 1.50 T. and 2.50 T. whilst the mean was 1.92 T.

* T=tons of commercial sugar per acre.

Two estates returned results from the White Transparent, the mean yield being 1.25 T.

D 4397 was reaped on 5 plantations, only one of which possessed over 20 acres of it. The mean return was 1.65 T. and the extremes of yield 1.00 and 1.86 T.

Diamond 185 was returned from three estates from areas of over 20 acres each. A mean yield of 1.82 T. was obtained, the highest being 2.12 and the lowest 1.59.

The minimum, maximum and mean yields of certain other varieties are shown in the following table:—

Canes.	*No. of Trials.*	*Yields in Tons of Sugar per Acre.* *Minimum.*	*Maximum.*	*Mean.*
D 216	3	1.60	2.49	2.14
D 167	2	1.70	2.50	2.10
D 118	4	1.60	2.22	1.95
D 116	2	1.56	2.25	1.90
D 721	2	1.75	2.00	1.87
D 419	4	1.44	1.99	1.80
D 4399	2	1.71	2.75	1.73
B 376	3	1.57	2.00	1.70
D 117	2	1.43	1.52	1.47
B 3956	3	1.19	1.51	1.30

Single trials only are reported with the following varieties, most of which gave results of some promise:—

Varieties.	*Yield of Sugar: Tons per acre.*
B 3412 ...	... 3.53
Diamond 581	... 2.80
Java 2 ...	... 2.35
„ 3 ...	... 2.32
RP 4 ...	... 2.30
B 1753 ...	... 2.27
RP 5 ...	... 2.24
RP 1 ...	... 2.22
Java 4 ...	... 2.20
Diamond 399	... 2 20
D 216 ...	... 2.00
B 190 ...	... 2.00
D 4395 ...	... 2.00
RP 89 ...	... 1.96
D 1087 ...	... 1.95
Java 1 ..	... 1.92
D 382 ...	... 1.91
Sealy ...	... 1.88

(C'td.) Varieties.	Yield of Sugar : Tons per acre.
P 28	1.82
J 100	1.81
D 74	1.80
P 10	1.77
J 247	1.70
B 109	1.65
Badilla	1.44

In all fifty-six varieties were reported as being under large scale cultivations and trials in 1913.

The results of the at present more important varieties were recorded from the following areas :—

Varieties.	*Areas.*
D 625	18,495
Bourbon	9,899
B 208	6,904
D 145	4,607
D 109	1,781
Diamond 185	848
Green Transparent	703
B 147	443
D 116	93
White Transparent	87
D 74	67
D 199	65
D 4399	63
B 376	61
D 4397	58
Diamond 399	36
R P 5	22
D 177	20
D 118	17

The following comparisons of the yields of certain varieties in 1911, 1912, and 1913 are of some interest :—

	Yield of Sugar: Tons per acre.		
Varieties.	*1911.*	*1912.*	*1913.*
B 3412	4.12	2.81	3.53
P 6	3.47	1.73	·97
Diamond 382	3.32	1.96	1.91
P 2	3.25	1.42	·74
D 199	2.08	1.15	1.48
D 419	2.07	1.50	1.80
Diamond 399	1.96	1.49	2.20
Diamond 581		2.55	2.80
B 1753		2.27	2.27

The data obtained in 1913 confirm earlier experience that certain new varieties when cultivated on the large scale and over widely distributed areas are capable of giving yields considerably in excess of those of the Bourbon in the condition it has been of late years. The Bourbon, however, in 1913 gave on the whole more satisfactory results than it has done for some seasons.

THE AREAS OF VARIETIES OF SUGAR-CANE FOR THE CROP 1914.

Reports have been received from 37 plantations showing the areas under cultivation in different varieties for the 1914 crops. All of these have areas under D 625 amounting to 31,130 acres, an increase of 5,760 acres on the area under cultivation in the previous year with this seedling variety; 27 plantations have 6,864 acres of B 208; 28 have 5,782 acres of D 145; 21 have 2,164 acres of D 109; 5 plantations have 1,431 acres of Diamond 185; 9 have 1,116 acres of Green Transparent; 9 have 261 acres of B 147; 9 have 169 acres of D 118; 5 have 157 acres of D 116; 2 have 140 acres of Java 100; 2 have 116 acres of D 115; 7 have 95 acres of D 419; 7 have 91 acres of D 4397; 8 have 74 acres of D 4399; 2 have 71 acres of D 74; 4 have 63 acres of B 376; whilst 3 only now have White Transparent under cultivation with a total area of 46 acres.

The following table shows the increase or decrease in the acreage cultivated in the different seedling and other varieties in 1913:—

Varieties.	*Increase.*	*Decrease.*
D 625	5,760 acres	
Bourbon		617
B 208		1,377
D 145	291	
D 109		591
Diamond 185	154	
Green Transparent	366	
B 147		291
D 118	111	
B 116	54	
Java 100	132	
D 115	13	
D 419	95	
D 74		3
D 4397		6
D 4399		31
B 376		10
White Transparent		117

In addition to the above mentioned more important varieties 72 were returned as being under trial cultivation on areas of from one acre to 43 acres each. A very large number of varieties are under trial in the nurseries of the various plantations.

50,602 acres are now occupied by canes other than the Bourbon as compared with 48,633 during 1913, the increase being equal in round figures to 4·5 per cent.

The area occupied by the Bourbon cane has been reduced from 19,250 acres in 1913 to 18,633 for the crops of 1914. The total area under sugar-cane being 69,255 acres, 73·1 per cent. of it is now cultivated in varieties other than Bourbon.

Blackwater Fever.

Dr. J. W. Collett, of Sierra Leone, states that the clinical evidence of blackwater fever cases appears to indicate, with every aspect of certainty, that the disease is due not to any definite, single specific poison, but simply to the establishment of an unstable condition of pressure in the circulation resulting from a variety of causes. Intense or untreated infections of subtertian malaria appear to be one agent which produces this unstable condition of the blood, muscular exertion another, extreme constitutional debility from any cause another, and the administration of quinine in a weakly condition of the body yet another. The theory recently advanced that the cause of blackwater is the poison from the bite of some insect needs the support of further evidence to give it *locus standi* with investigators. He adds that the condition of pyrexia induced by the absorption of the chemical active rays of light from the sun, and the resulting deleterious effects on the body protoplasm, is a subject that has received scant attention in the past. Only recently has it been appreciated that a number of the so-called local fevers, low temperatures, feeling of malaise and lassitude, and general indisposition are due to light intoxications. The question is of considerable interest and one which will repay careful consideration.

—Colonial Office Journal, June, 1914.

Sargasso Weed.

The Sargasso Sea through which Columbus passed on his first voyage to America is characterized by the scattered masses of gulf weed which float on the surface of the ocean in patches generally from fifty to a hundred feet in diameter. The question as to the origin of the gulf weed has never been definitely settled. Some consider that the gulf weed—whose botanical name is *Sargassum bacciferum*—is merely a mass of sterile branches of some species of *Sargassum* which grows attached in the region of the West Indies.

—"Science," June 5, 1914.

The Cultivation of Vegetables.

By J. F. Waby, F.L.S., F.R.H.S., I.S.O.

PART II.

We will now mention a few of the best vegetables which are in fairly common demand and for which nothing much more than ordinary cultivation is needed.

Beans. The dwarf French or kidney bean, *Phaseolus vulgaris,* a most desirable vegetable in many hybrid forms, can be grown without much trouble provided the birds are kept away from them; birds attack the young shoots as soon as they are above ground and continue their attacks if allowed to do so till not a scrap remains. They are fairly prolific and each sowing of an ordinary sized kitchen garden bed will supply the table at intervals for several weeks. The seeds should be sown in shallow drills,—2 drills to a bed 5 feet wide, —in 2 rows a few inches apart, 6–8 inches apart in the rows and lightly covered. When they have their first pair of leaves they should be earthed-up, (moulded), *i.e.*, the drills filled up a little higher than the general level of the soil, giving the young plants more stability; beyond an occasional hoeing between the double rows to prevent the soil caking and weeds growing, they will require little more than watering. As soon as the first bed begins to bear, a second should be sown for succession. Pick the beans before the seeds harden.

The tall growing varieties should be planted further apart,—as their tops cover considerably more space,—and sticks provided on which to climb. These last much longer than the dwarf kinds and need not be sown so frequently.

Lima beans, *Phaseolus lunatus,* of various hybrid dwarf forms. These are most delicious vegetables, especially those of the last few years' production, but they are not very prolific in the tropics. They require more room than the French-beans as they make dwarf bushes. Some of the tall-growing forms are worthy of a place in the garden and do even better than the dwarf kinds; like the tall-growing French-beans they require space to spread and sticks for climbing. Lima beans are always used shelled; pick the beans when the seeds are full.

Bonavist beans. *Dolichos Lablab.* The dwarf annual variety is a most useful bean to grow. It makes small bushes, 2–3 feet wide, yielding profusely. There are several varieties of climbing perennial Bonavists, mostly with purplish flowers, fairly common, but of a rather coarse nature, lasting with ordinary care through several seasons, requiring a fair amount of space on an outside railing or fence on which to trail,—which are by no means to be despised lacking better material; but one kind especially is worth a place in every garden, *D.L.* var *nankinicus.* This has pure white flowers, the pods short much like green peas, the seeds also like peas, the flavour of which is much more delicate than of any of the others. They can be grown on the palings or fencing of the garden where they exist, or on sticks, or on an arbour; sow 2 or 3 seeds together and give them plenty of room between the sowings. Given fairly rich soil the crop will be good. All Bonavists are used shelled. Pick the pods when they are full, before the seeds get hard.

A VALUABLE NOVELTY.

A form of Dolichos introduced to Georgetown during the past few years from the Interior by Mr. John Park, is a decided acquisition and one of the best which can be grown. Folks from the "Old Country" know well their "Scarlet Runners" so much grown in every cottage garden, a standard vegetable for the late Summer and Autumn; this bean easily takes its place both as to its bearing quality and its place at table, used in the same way, *i.e.*, whilst the beans are young and before the seeds are hard. On account of its similarity in these respects it has been named "Scarlet Runner" though its flowers are purplish. Give it plenty of room in a bed and sticks to climb on, or on a fence. The pods must be picked as are those of French-beans so that they will easily slice. It is really the best introduction of late years for the table, equal to French-beans and much less delicate to grow, in fact there is no more trouble with it than with the common Bonavist. It can also be used shelled like the Bonavists.

We will finish the beans with the Goa-bean, *Psophocarpus tetragonolobus*; it is also called, Square-bean, Winged-bean and Sequidilla, introduced a few years since from India. It is a strong climber, well suited for covering palings or outside fences, lasting several years with care, though as seeds are produced in plenty there is no need to keep the plants more

than a year. The flowers are of a pretty blue colour, resembling sweet-pea flowers, borne profusely. The fruit, a square bean about 9 inches long, is 4 winged ; the seeds brown, of the size of ordinary peas. The beans must be used when not more than half grown, cut up, or sliced and cooked in the same manner as French-beans, to which they are scarcely inferior. Prepare places liberally supplied with manure, at distances 9–12 feet apart, sow 2 or 3 seeds together and they will soon cover the spaces between.

Cabbage, *Brassica oleracea*. The difficulty with this has been to obtain a variety suited to the tropics. Experiments have been going on for several years for this purpose. The large-headed kinds are of no use ; they make a big show forming large plants with large spreading leaves and then fail to "head." The small growing elliptical forms are those to be chosen and these do remarkably well. Forms like the "Jersey Wakefield," especially the improved kind, "Early Jersey Wakefield," have given good results. A round-headed form, "Surehead," has done fairly well but nothing to compare with the small elliptical forms ; the same may be said of the "All Head" variety. The seeds should be sown thinly and the plants pricked off a few inches apart when they have 2–3 leaves ; when strong transplant to their permanent positions in drills, giving the plants 9–12 inches each way, alternating in the rows ; when they have become established earth up the rows to give stability. The soil must be kept broken up between the plants to prevent caking. They require a free rich soil.

BEET-ROOT.

Beet, *Beta vulgaris*. A decided luxury, yet one which can be indulged providing the heavy wet weather does not interfere. It grows sufficiently well to warrant its being more often on the table than it is. Here again the kinds must be chosen with regard to their suitability. It is useless to choose large growing kinds because in the rapid growth induced by the heat they run away to leaf without any enlarged base. The small growing table-beets, such as "Red Globe," "Blood Red Globe," and "Crimson Globe or Ball," should be the kinds tried as these have already given satisfaction. They are delicate plants to deal with and care must be taken with watering. Sow in drills, 6–9 inches apart and when the plants are sufficiently grown for transplanting, thin out in the rows

to 6–9 inches apart, and those which must be pulled out transplant to other beds at a similar distance ; whilst the plants are weak give as little water as possible,—though they must not be neglected,—and a little shade would be beneficial. As the balls begin to swell give them a light moulding.

Swiss Chard, or Spinach Beet. This is a kind of beet which does not form a ball at the base. It grows about 1½ feet high with thick, succulent, whitish leaf-stalks and broad crimpled blades. The whole top can be used, stalks and blades separately, forming two separate vegetables ; the stalks served as asparagus or Sea-kale, and the blades as spinach. Sow the same as beet, and when strong enough transplant in rich soil about a foot apart. This is not so susceptible of water as beet, and can be freely supplied with it.

Carrot, *Daucus Carota.* This delights in a sandy soil—though not too much of sand ; in heavy soil it will "club" ; it can be grown all the year round with due regard to succession. Sow thinly in drills, thin out to about 6 inches apart and transplant those taken out of the drills. Choose the short growing kinds, such as "Short-horn," or "Oxheart" ; deep rooting kinds are of little use here, except it may be in some of the country districts where the soil is light and deep.

TOMATOES.

Tomato, *Lycopersicum esculentum*, of many hybrid forms and varieties, large and small fruited, and of varying shades of red and yellow. Most of them bear abundantly, some to such an extent that it is advisable to thin out the fruit to ensure the crop being good and well formed. They are strong feeders, therefore the soil must be good, and when in full bearing should be heavily mulched with manure and liberally supplied with water. Sow thinly, either in the open bed, or in boxes, prick out when a few inches high to a few inches apart so as to obtain strong plants, and then transplant to their permanent positions. If left in the seed bed or boxes without being pricked off, they are likely to become spindly and cannot make strong plants as desired. They should be planted at least 3 feet apart, the plants of one row alternating with those of the other ; by giving plenty of space between the plants they will branch low and freely, frequently requiring the removal of some of the branches to prevent crowding. The great fault in tomato growing is crowding, it is impossible to obtain good well-formed fruit when this is the case. Do not let the

branches grow long ; when 2 or 3 sets of flowers have formed take off the ends, this will keep the bushes fairly low and throw more vigour into the bearing branches. Supports will be needed to prevent the branches breaking down as they are brittle at the joints ; these should be arranged so that the branches do not overlap, thus allowing air and sunlight to penetrate freely for the ripening of the fruit. As soon as the first batch is in full fruit sow another set to keep up succession.

Peppers, *Capsicum annuum*, of very many varieties. Grow these in the same manner as the tomato, as they all form compact bushes they do not need supports.

Egg plant, Belangine, or Boulanger, *Solanum melangena*. Grow these like the tomato and peppers. Those who like large fruits of a good quality should try the "Black Beauty," it is of a purplish-black colour, globular in form, as large as a small child's head.

Okra, Ochro, Gumbo, *Hibiscus* or *Abelmoschus esculentus*. This is a well known subject, though rarely well grown. It requires similar treatment to the tomato, rich soil and plenty of water. Generally little attention is paid to the Ochro ; it is allowed to grow its own way making scraggy, leggy plants which soon exhaust themselves. After they have begun to bear well and whilst they are still vigorous they should be pruned back and made to branch low down thus lengthening the life of the plants and prolonging their producing powers. The pruning must be supplemented with a heavy mulching of manure and copious supplies of water, for they are very thirsty plants. The "Lady's Finger" and "Keckley's Favourite" are the best.

Indian-Kale, *Xanthosoma atrovirens*. This is a dwarf tannia-like plant with small sagittate foliage, grown for the leaves alone and used as spinach when young. Propagate by dividing the stools and plant in rows 6–9 inches apart, and a similar distance between the plants.

Horse-radish, *Cochlearia armoracea*, a deep-rooting perennial. The soil must be dug deeply and made fairly rich ; it requires little attention after being planted beyond keeping it free of other plants and the soil kept open. Take off-sets and place well below the surface about 2 feet apart ; a

narrow side-bank or ridge is more suitable for this plant than a bed.,

CUCUMBERS.

Cucumber, *Cucumis sativus.* Generally these plants are allowed to run at their own sweet will without any attention whatever beyond watering and perhaps a few sticks on which to trail ; they are however fairly prolific and serve their purpose. Needless to say they require some attention if they are to be satisfactory. The soil must be rich and deeply dug for they are gross feeders. The seeds may be sown at once in the permanent position, but it is usual and preferable to sow in pot or box and transplant when quite strong and before the plants begin to run. A space of at least 6 feet on each side should allowed for each plant ; pinch out the growing point to make it branch and continue pinching as it extends till sufficient branches are formed, removing any which crowd ; laterals will soon appear bearing fruit, take off each point at the first joint past the fruit, retaining the leaf : fertilize each fruit as the flower opens and remove all male flowers not needed for this purpose. Slight shade is beneficial and prevents scorching. They are thirsty subjects but water must not be allowed to remain about them. A good strain of cucumber is easily kept true to stock by layering and cuttings.

SQUASH.

Squash, *Cucurbita melopepo.* Grow this exactly the same as the cucumber, except that it requires a trellis so that the fruit can hang, and the point must not be pinched off till it has reached the height of the trellis, in every other respect treat similarly.

PUMPKIN.

Pumpkin, *Cucurbita pepo.* This is another subject which is always allowed to grow in its own way covering a large space most unnecessarily. Grow this in exactly the same manner as the cucumber and it will be found that a large number of fruits will be borne in a comparatively small space. It is a good subject for an arbour treated as stated for cucumbers.

Lettuce, *Lactuca sativa.* This should be on the table every day and except for neglect in the succession there is but one other reason for this not being the case and that is the failure of seed to germinate which unfortunately sometimes happens.

It must be grown quickly so that it may be crisp and sweet, and for this the soil must be free and rich, otherwise it will be leathery and probably bitter. Sow thinly in a bed or box in fine soil, covering very lightly and water immediately; keep close-shaded for a few days, prick-off as soon as large enough to handle and in about a fortnight afterwards they will be ready to transplant into the beds. Plant in rows 6-8 inches apart each way alternately, shade for a few days. As soon as the plants of the first sowing are established sow another lot for succession. The Cabbage Lettuce is the best to grow, such as "Tom Thumb," "May King," and the "Deacon." Cos Lettuce is not nearly so satisfactory and "runs away" much more quickly, rarely heading.

Radish, *Raphanus sativus*. This is the quickest growing esculent we have, giving little trouble; the soil must be free and rich to prevent heat and fibre. Sow thinly in a well prepared bed either broadcast or in drills and just cover the seeds. Keep the soil free and thin out where too thick. Sow a second bed for succession as soon as the bulbs of the first begin to form.

Celery, *Apium graveolens*. Treat the same as Lettuce and when the plants are sufficiently strong transplant to permanent beds 1-1½ feet apart; these will soon be fit for use for flavouring or garnishing. Planting in trenches and earthing up for blanching as is done in Europe is a failure here; the plants grow well for a certain time and give good promise, but if heavy rain sets in the plants are destroyed. A certain amount of blanching may be effected by placing collars of tin or cardboard around the strong plants in the ordinary bed after taking off the bottom leaves, this excludes the light and water does not settle around the plants. It is possible that persons living in the country may possess higher land than that about Georgetown, and it would be a good thing to attempt the cultivation of Celery in such land: dig a drill fifteen inches wide and a foot deep throwing the soil out on both sides; dig the bottom a good foot deep and manure heavily; put in the plants 1½ feet apart, when these have grown so that the tops meet, take off a few of the old leaves and mould the plants two or three inches with the soil thrown out by the first digging; as the plants continue to grow keep up the moulding, taking care not to cover the heart of the plants; should there be no heavy rains, or the ground is well drained so that water does not settle in the drill there is the possibility of success.

Report on the Experimental Bleeding of Balata Trees at Onderneeming.

By C. K. Bancroft, M.A., F.L.S., Government Botanist, and S. H. Bayley, Superintendent Onderneeming Farm.

THE following experiments on the bleeding of balata trees were conducted at Onderneeming from July 28th to September 13th by Mr. C. K. Bancroft, M.A., F.L.S., Government Botanist, and Mr. S. H. Bayley, Superintendent of the Onderneeming Farm.

The analyses detailed in the report were made in the Government Laboratory by Professor J. B. Harrison, C.M.G., assisted by Mr. L. S. Davis.

Some determinations of the proportion of balata in the bark of not tapped and tapped balata trees are recorded in the report of the Government Analyst for the year 1884. The data there given can be used as a guide for determining whether in the trials by Messrs. Bancroft and Bayley, the bark was or was not thoroughly bled. The results on dry (moisture free) barks work out as follows :—

	Jenman and Francis. 1884.	Bancroft, Bayley and Harrison. 1913.
Balata from not tapped area...	11·12	14·50
Balata from tapped area, British Guiana method	7·99	4·50
Balata from tapped area, Venezuelan method ...	...	8·72

It is evident that in the recent trials the balata trees were very skilfully tapped and thus thoroughly deprived of the latex by the British Guiana method ; 70 per cent. of the balata in the bark being extracted therefrom as compared with 28 per cent. in the earlier trials.

The experiment had for its object an enquiry into the system of bleeding which is at present in use in this colony and the comparison of the yields obtained by this system with those obtained by other systems, more particularly that which is at present employed in Venezuela. The experiment was conducted at His Excellency the Governor's request and was planned and carried out under the direction of the

Director of Science and Agriculture. It represents, to the best of our knowledge, the first attempt of its kind with respect to a latex-bearing tree in its natural state.

PREVIOUS RECORDS.

For data with respect to the yields obtained from the tree, modes of bleeding, &c., we have consulted "Les Plantes à Caoutchouc et à Gutta" by Jumelle, 1903, "Rubber and Balata in British Guiana," 1911, issued by the Department of Science and Agriculture, and we have had access to various notes and reports in Government papers.

CONDITIONS AFFECTING THE EXPERIMENT.

Under the advice of the Director of Science and Agriculture the place selected for the experiment was an Indian Reserve situated at the back of Onderneeming School Farm. The majority of the trees were growing on a sandy soil; some were growing in a swamp in pegass. The land was flat or in part very gently undulating.

The average annual rainfall is 96 inches and that for the period of the experiment was 13¼ ins.

The trees were growing in virgin forest and were all "virgin" trees, i.e., they had not been previously bled. They covered an area estimated at 5 square miles and extended to 3½ miles beyond the back of the Farm.

METHOD OF EXPERIMENT.

The trees were first selected from the point of view of their growth and situation and were grouped together for the different systems of bleeding. Adjacent trees were allotted as far as was conveniently possible to different systems, and an attempt was made to obtain a nearly similar girth of the trees for the different systems.

The trees were numbered by means of stencilled labels, and connecting paths were made from tree to tree.

Bleeding was commenced as early as possible in the morning, a greater yield being obtained at this time than during the heat of the day, as is common in other latex-bearing plants. In the case of the trees whose latex was extracted after felling, the felling was done in the late evening and the bleeding carried out the next morning.

The bleeding was conducted by a skilled bleeder of some 20 years' experience. The milk was collected in calabashes, transferred to kerosene tins and transported to the Farm where it was poured into wooden boxes, 1½ x 2 feet, lined with a layer of soap so as to prevent leakage and to permit of the coagulated gum being easily removed. The gum was coagulated by evaporation and removed as a sheet from the box.

The gum was weighed after removal from the box at the end of one week and again at the end of six weeks. The loss of weight on the two weighings was found to be a negligible quantity.

Before the experimental bleeding was commenced, a day was devoted to felling and bleeding a tree and also to bleeding a standing tree so as to ascertain the best plan to be adopted in the experiment. Special knives were also used on preliminary trial. The first experiment was then carried out as follows :—

Twenty trees were employed, grouped into four lots A, B, C and D and numbered A_1, A_2, B_1, B_2, etc. The girths of the trees were taken at 4 feet from the ground, the standard height adopted by the Lands and Mines Department for measuring the girths of the trees, and the distance from the position of the lowest cut on the tree to the fork was measured. The trees were bled to the fork. The process of bleeding consisted in scraping with a cutlass the area of bark to be bled so as to render it smooth, affixing a collecting calabash by raising a portion of the bark and inserting the lip of the calabash between this and the wood of the tree (in the case of a felled tree a calabash was placed below each cut), and then cutting the bark by means of a cutlass or knife according to the method of bleeding employed. The same mode of procedure was adopted in experiments 2 and 3.

EXPERIMENT 1.

The experiment was divided into :—

A. Trees bled by a cutlass employing the feather-stitch pattern of cutting on one-half the circumference of the tree as is at present in use in the Colony.

B. Trees felled and bled by the method employed in Venezuela with cuts at right angles to the axis of the trunk Each cut occupied one-half of the circumference of the tree and the cuts on either side of the trunk alternated with each

other. The cuts on each side were 10 inches apart. Each tree was felled at 3 feet from the ground so that its trunk remained propped on the cut end of the stump in order to facilitate bleeding and collecting on the lower part of the trunk. The method which is described by Jumelle was followed as closely as possible.

C. Trees bled by means of a system of connecting V-shaped cuts with a common vertical channel, the cuts being 10 inches apart and occupying one-half of the circumference of the tree. A "pull" knife made locally was employed for making the incisions. (It had been found that a gouge such as is employed in tapping Jelutong, *Dyera costulata*, in the Malay Archipelago could not be employed owing to the fibrous nature of the bark of the tree).

D. Trees bled by means of a herring-bone system with cuts 10 inches apart. The same knife being used as in C. above.

The yields obtained by these methods are shown in Table 1. If the yields obtained by the method at present in use in this Colony be compared with those obtained by the method employed in Venezuela it will be seen that the total difference in yield is 1 lb. 9 ozs. in favour of the latter or a difference of 5 ozs. per tree. The yields obtained in C and D are considerably less than those in A and B. Another method of comparing the yields by these systems, and one which perhaps offers a more favourable comparison, is to accept the area of bark bled as the basis of comparison. The area of bark bled was approximately calculated by multiplying the circumference of the tree at 4 feet from the ground, one-half of the circumference, by the height to which the trunk was bled. In this way the following results are obtained:—

Approximate yield of dry balata per square foot of bark bled.

A. Local method	...	·46 oz
B. Venezuelan	...	·25 oz.
C. V-system ...	...	·24 oz.
D. Herring-bone system		·24 oz.

EXPERIMENT 2.

Having obtained the above results it was decided to abandon the two systems C and D, as they appeared to yield considerably less than the other systems, and to carry out another experimnet employing both the methods A and B above and

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also bleeding standing trees around their whole circumference, in order to compare these latter with the felled trees in B All of the trees were bled by a cutlass. Fourteen trees were allotted to this experiment and these were divided into :—

G. Trees bled by the Venezuelan method as in B above.

H. Trees bled by the feather-stitch pattern around the whole circumference.

X. Trees bled by the method at present in use in the Colony. The trees obtained for X were only four in number and were considerably smaller than those in G and H, and the comparison of the yield of these with the latter trees can scarcely be regarded as fair as regards the actual yields, although the yields obtained from them per area of bark bled is high.

The following yields were obtained :—

G. Five trees (Venezuelan method) 14 lb. 2½ oz.

H. Five trees (whole circumference, standing) 15 lb. 5 oz.

X. Four trees (half circumference, standing) 7 lb. 11½ oz.

The yield per tree is :—

G. 2 lb. 13 $\frac{3}{10}$ oz.
H. 3 lb. 1 oz.
X. 1 lb. 14⅜ oz.

Calculated on the basis of area of bark bled as in Experiment 1, the results are :—

G. .25 oz.
H. .35 oz.
X. .66 oz.

EXPERIMENT 3.

In the two above experiments the trees had been bled only as far as the main fork, as is usually done both in this colony and in Venezuela. It was, however, obvious that the cuts could be extended above the main fork of the tree on the lower parts of the branches both in felled and in standing trees ; and in order to compare the yields of trees bled in this way by the British Guiana and Venezuelan methods, a third experiment was commenced. Only four trees were available for the experiment. The total height of the stem and branches which,

was bled, was in the British Guiana method 74½ feet and in the Venezuelan method 97½ feet. The yields obtained were:—

British Guiana method 5 lb. 0 oz.

Venezuelan 4 lb. 5 oz.

an excess in favour of the former of 11 oz.

This concludes the actual experiments for comparison of the yields obtained by different systems of tapping, all being based on the extraction of the latex at a single tapping.

EXPERIMENT 4.

As an alternative to this an experiment was made to ascertain whether the tree had any wound-response, as occurs in some latex-bearing plants which are exploited commercially at the present day, notably *Hevea brasiliensis* (Para rubber tree) and *Dyera costulata* (Jelutong tree). If any appreciable wound-response was present, the tapping of the tree by opening up the cuts afresh at short intervals of time, would naturally suggest itself as an alternative to the extraction of the latex at one tapping. Accordingly one tree was selected and bled at intervals of 48 hours by means of a basal V-cut 4 feet high, the cut being opened afresh every 48 hours on the upper as well as on the under side. A flow of milk was obtained on the first day, but no further flow was recorded in subsequent tappings. This absence of flow had also been previously indicated by a few trials on some trees in which oblique cuts were made at intervals of 6 inches on the trunk and the intervening portions of bark were again bled on the following day, no flow of milk resulting at the second bleeding.

EXPERIMENT 5.

The apparent absence of wound-response is also shown in the following experiment in which an attempt was made to ascertain the maximum distance of the cuts apart which would extract all the available latex from the bark, *i.e.*, which would give a maximum of yield. In this two trees were employed, one measuring 36 inches in girth at 4 feet from the ground and the other 46 inches. V-cuts were made at intervals at 6, 12, 18 and 24 inches in one tree from below upwards and in the other from above downwards. The trees were bled by these cuts and 24 hours afterwards the intervening portions of bark were again cut to ascertain whether there was any flow.

The results obtained agreed in the two trees and were as follow :—

Distance apart of cuts.	*Yield from intervening bark.*
Cuts 24 inches apart.	Good.
„ 18 „ „	„
„ 12 „ „	Appreciable.
„ 6 „ „	None.

This indicated that the desirable distance of the cuts apart which would extract a maximum of latex was between 6 and 12 inches. Fresh cuts were made at intervals of 8 and 10 inches. In those at 10 inches apart the milk oozed slightly in some cases when the intervening bark was cut, while in those at 8 inches there was no flow.

This concluded the experiments, which have been carried out in order to ascertain data with respect to the bleeding of the tree.

CONCLUSIONS BASED ON THE EXPERIMENTS.

The results obtained in the Experments 4 and 5 indicate that there is no appreciable response after wounding the bark of the tree. From this it is indicated that a system by which an attempt was made to extract the latex by paring away the bark at intervals or by bleeding portions of bark intervening between previous cuts would not be successful. While the results of Experiment 5 would indicate that a maximum yield can be obtained by bleeding the bark with cuts as far as 8 inches from each other. We also observed that the renewed bark on trees which had been previously bled did not yield freely unless an interval of some years had elapsed. From this it is concluded that it is desirable that the milk should be extracted at a single bleeding as was attempted in the Experiments 1, 2 and 3.

YIELDS OBTAINED FROM STANDING TREES BLED THE WHOLE CIRCUMFERENCE.

Turning then to the results obtained in these experiments, if the results of tapping of trees by the Venezuelan method, by the method now in use in British Guiana and by a modification of the latter in which the whole circumference of the tree was bled, instead of half the circumference, be compared, they show that the greatest yields obtained were by the last named method, and in no case did the yield from the trees which were felled and bled over the whole circumference exceed the yield

obtained from the trees which were bled around the whole circumference while standing in Experiment 2.

THE VENEZUELAN AND THE LOCAL METHOD COMPARED.

The yield obtained from trees bled by the British Guiana method in Experiment 1 gave per tree 5 oz. less of dry balata than those bled by the Venezuelan method ; in Experiment 3 they gave 5½ ozs. more per tree ; in Experiment 2 they gave 14½ oz. less per tree. In the last named it has been previously pointed out that the trees bled by this system were smaller than those bled by the other system ; while the larger trees in the experiments have generally given the greatest yields. If the results of all of the bleedings be taken together the yields obtained per acre are :—

British Guiana method	...	...	...2 lb. 0 oz.
Venezuelan method	...	...	...2 lb. 7¼ oz.

a difference of 7¼ oz. per tree. The felling of the tree before bleeding, as is done in the latter system, necessitates the employment of two men, while one can bleed a standing tree ; it takes longer to execute and it frequently necessitates the felling of one or more of the surrounding trees so as to allow of a clear space for the tree to fall ; it necessitates the conveyance of additional implements, viz., axes, calabashes or collecting vessels. All of these render collection of milk more difficult. Further it destroys the tree, the value of which for timber in this colony is well known. In order, therefore, to compensate for the difficulties ensuing in this method of extracting the latex, very large yields should be obtained. The experiments do not indicate that comparatively large yields are obtained by this method.

TAPPING THE WHOLE OR HALF OF THE CIRCUMFERENCE OF THE STANDING TREES.

The tapping of the whole circumference of standing trees may be expected to be more injurious than the tapping of one-half of the circumference ; while in the hands of other than a careful bleeder it may easily result in the death of the tree. The tapping of one-half the circumference of a tree by the local method is the most efficient system, yielding far greater than any of the others per area of bark bled.

HERRING-BONE AND V-SYSTEMS OF TAPPING.

The yield obtained by these systems were comparatively low. This may be due partly to the fact that the bleeder was not

sufficiently skilled in the use of the knife. The yields obtained are so low that they indicate that the V-systems which are employed in tapping plantation Para and other plantation rubber trees are unsuited to the bleeding of the bullet tree.

THE USE OF THE CUTLASS AND THE KNIFE.

Trials were made with three knives—one a "pull knife" made locally under our direction, another a simple gouge, and a third knife obtained from Surinam for which good results had been claimed. Our observations showed that the use of a gouge was not practicable owing to the fibrous nature of the bark, while a greater yield was clearly indicated by the use of the locally made knife than by the Surinam knife. When compared with the cutlass we found that a knife tends to tear the bark and does not make a clean cut; this is due to the fibrous nature of the bark. And further, with the cutlass a vertical as well as a horizontal cut is obtained; so it may be expected that a larger number of latex cells are opened with the cutlass than with the knife. The cutlass is easy to use at heights on the tree and it is cheap and can be easily sharpened; while with ordinary care our observations showed that it does not penetrate to the wood of the stem. Its use is in our opinion preferable to that of a knife.

DISTANCE OF THE CUTS APART.

It is concluded that a vertical distance of between 8 and 10 inches apart of the cuts will extract a maximum quantity of milk.

ANALYSIS OF BARKS AND BALATA.

In addition to the experiments on the bleeding of the tree as set forth in the above, analyses of the bark and of the balata from different trees have been made. The primary object of these analyses was to ascertain whether any evidence could be adduced from them in support of the conclusions drawn frem the experiments on bleeding. The following analyses were made :—

(*a.*) Three samples of bark taken from the bottom, (2½ ft. from the ground), middle and top (at the main fork) of the trunk of a tree which had been felled for the purpose in the area in which the bleeding experiments were being conducted. The samples were obtained by removing an area of bark 18 inches in length, the whole circumference of the tree in width and the whole of its depth from the surface to the underlying wood and were placed in sealed kerosene tins. The analyses were made from portions taken from the middle of the samples

so as to avoid any errors which might be due to loss of [illegible] from the incisions made in removing the bark. The results of the analyses were :—

	Moisture %.	Gutta %.	Resin %.
Bottom of tree	53·00	2·54	2·68
Middle of tree	54·00	2·85	2·90
Top of tree	62·40	2·14	2·18

(*b.*) Two samples of bark were taken after the tree had been bled by the Venezuelan method—at different parts of the stem the one higher than the other. The average of the two analyses were :—

Moisture %.	Gutta %.	Resin %.
61·0	1·34	1·91

(*c.*) Two samples were taken as in (*b*) from a tree after it had been bled by the British Guiana method. The average of the two was :—

Moisture %.	Gutta %.	Resin %.
62·0	·68	1·58

(*d.*) Samples of balata were taken from trees tapped by different sys ems and were analysed for the percentage of moisture, resin, gutta and impurities. The results were as follow :—

ORIGIN OF SAMPLE.

	Mois ure %.	Gutta %	Resin %.	Impurities
Tree bled by British Guiana Method.				
	7·20	39·26	41·62	11·92
	7·30	40·59	40·13	11·98
Means ...	7·25	40·42	40·87	11·96
Tree bled by Venezuelan Method.				
	4·30	38·51	43·71	13·48
	6·40	41·30	38·29	14·01
Means ...	5·35	39·90	41·00	13·74
Tree bled on V-system.				
	5·30	35·11	48·69	10·90
	5·40	39·57	41·81	13·22
Means ...	5·35	37·34	45·25	12·06
Tree bled by Venezuean Method.				
	5·20	36·08	45·25	12 45
	8·80	37·41	46·27	14·69
Means ...	7·00	36·74	39·10	13·57
Tree bled by British Guiana Method on the whole circumference.				
	9·00	41·64	38·82	10·54
	2·20	45·20	43·50	9·10
Means ...	5·60	43·42	41·16	9·82

CONCLUSIONS BASED ON THE ANALSYES.

The following conclusions are deduced from the results of these analyses :—

The results of the analyses of the samples of balata were employed to calculate a *normal* balata the approximate composition of which was arrived at by taking the mean of the analyses of the samples in *d* and is as follows :—

Moisture.	Gutta.	Resin.	Impurities.
6·1	39·5	42·2	12·2

Employing this normal balata of the above composition as a basis of calculation it is possible to estimate the amounts of balata in the barks which were analysed in *a*, *b* and *c* above, from their gutta content. These balata contents are then :—

		Normal Balata Content of the bark.	
a. Tree not tapped—	Bottom ...	6·4 %	
	Middle ...	7·2 ,,	6·3 % average.
	Top ...	5·4 ,,	
b. Tree after having been bled by Venezuelan Method ...		3·4 %	
c. Tree after having been bled by British Guiana Method ...		1·71 ,,	

From these results the residue of balata in the bark after bleeding is considerably less when the British Guiana method is employed than when the Venezuelan method is employed. In other words they indicate a greater efficiency of extraction from the former method than from the latter and support the conclusion arrived at from the results of the bleeding experiments.

This is the main point which is borne out by the above analyses. Some other facts, however, which may prove of more than scientific interest are indicated in the analyses. Such are the difference in the relative proportions of gutta to resin in the bark before and after tapping, as is indicated in *a*, *b*, and *c* above the difference in the relative proportions of gutta to resin in balata yielded by systems of different degrees of efficiency as is indicated in *d*, the difference in the content of normal balata in parts of the bark as indicated in *a*. These must form the basis of further research at some future time, inasmuch as they may throw some light on the part played by these substances in the economy of the life of the plant of the nature of which there is at the present little known.

OTHER CONCLUSIONS.

With respect to the time of healing of the wounds made by bleeding we are unable to furnish any information, as the experiments have only been recently conducted. If bleeding is conducted with ordinary care there appears to be no exposure of the wood to decay induced by water or to the attacks of insects. The fact that trees have been bled on renewed surfaces of bark in certain parts of the colony indicate that with care a good renewal of the bark can be obtained.

The use of stirrups for climbing the trees should be prohibited owing to the unnecessary wounding caused thereby. There would appear to be little difficulty in climbing by means of a ladder and rope.

YIELDS PER TREE.

The average yields per tree in the experiments from the better systems of tapping vary from 1 lb. 14 oz. to 3 lb. 1 oz. The greatest yield obtained from any one tree was 4 lb. of dry gum. It may be said that in the experiments the yields of the trees were fairly uniform. In "Rubber and Balata in British Guiana" the average yield per tree is given as 5 lb.; while in a good season it is said that 25 lb. per tree has been obtained. Jumelle gives the amount taken from trees in Venezuela as a little less than 5 lb. a tree. And on enquiry we have ascertained that 5 lb. a tree is regarded as a good yield.

SPECIES OF BULLET TREES.

Two distinct species of bullet trees were noticed, the most obvious distinguishing character being the sizes and shape of the leaves. Both species appear to be exploited commercially for balata in this colony. Specimens of both of these have been sent to Kew for identification.

BALATA EXPERIMENTS.—Table I.

Mark.	Girth 4 ft. from ground.	Height tapped.	Yield of dry gum. lbs.	Yield of dry gum. ozs.	Remarks.
A 1	54 inches ...	30 feet ...	1	8	These trees tapped by methods usual in British Guiana, half circumference of tree only.
A 2	63 " ...	30 " ...	2	11	
A 3	37 " ...	32	1	2	
A 4	45 " ...	28 " ...	2	1	
A 5	57 " ...	32 " ...	2	1	
Totals ...	256 " ..	152 " ...	9	7	
Average ...	51 " ..	30⅖ " ...	1	14	
B 1	51 inches ...	34 feet ...	2	9	Tapped in Venezuelan method, viz., tree felled and ringed.
B 2	44½ " ...	38 " ..	2	6	
B 3	56 " ...	37 " ..	2	7	
B 4	43 " ...	31 " ...	1	9	
B 5	44 " ...	35 " ...	2	1	
Totals ...	238½ " ...	175 " ...	11	0	
Average ...	48 " ...	35 " ...	2	3	
C 1	55½ inches ...	25 feet ...	1	1	These trees tapped with a patent knife—V's.
C 2	38 " ...	25 " ...	...	11	
C 3	46 " ...	26 " ...	...	10½	
C 4	42 " ...	25 " ...	..	8½	
C 5	35 " ...	26 " ..	...	8½	
Totals ...	216½ " ..	127 " ..	3	7½	
Average ...	43 " ...	25⅖ " ...	...	11	
D 1	6 inches .	25 feet ..	...	13	Tapped with patent knife—herring-bone.
D 2	38 "	25 " .	...	13	
D 3 .. .	40 " ...	26 " ...	..	14	
D 4	35 " ...	26 " ..	..	6	
D 5	37 " ...	26 " ...	...	10½	
Totals ...	212 " ...	128 " ..	3	8½	
Average ...	42 " ...	25⅗ " ..	...	11	

BALATA EXPERIMENTS.—Table II.

Mark.	Girth 4 ft. from ground.	Height tapped.	Yield, lbs.	ozs.	Remarks
G 1	42 inches ...	47 feet ...	2	3	These tapped the whole circumference by Venezuelan method.
G 2	55½ ,, ...	37 ,, ...	1	14½	
G 3	51 ,, ...	43 ,, ...	4	0	
G 4	45½ ,, ...	40 ,, ...	2	4	
G 5	60 ,, ...	40 ,, ...	3	13	
Totals ...	254 ,, ..	207 ,, ...	14	2½	
Average ...	50⅘ ,, ...	41⅖ ,, ...	2	13 3/16	
H 1	58 inches ...	37 feet ...	3	15½	These tapped the whole circumference by British Guiana method.
H 2	57 ,, ...	30 ,, ...	2	15	
H 3	36 ,, ...	34 ,, ...	2	4½	
H 4	61 ,, ...	30 ,, ...	4	0	
H 5	45 ,, ...	25½ ,, ...	2	2	
Totals ...	257 ,, ...	156½ ,, ...	15	5	
Average ...	51⅖ ,, ..	31 3/10 ,, ...	3	1	
X 1	41½ inches ...	27 feet ...	1	11	These trees tapped by methods usual in British Guiana—half circumference, standing.
X 2	43 ,, ...	28 ,,	2	11¼	
X 3	36 ,, ...	27 ,, ...	1	10½	
X 4	39 ,, ...	30 ,, ...	1	10½	
Totals ...	159½ ,, ...	112 ,, ...	7	11¼	
Average ..	39⅞ ,, ...	28 ,, ..	1	14⅞	

BALATA EXPERIMENTS—BRANCH TAPPING—Table III.

Mark.	Girth 4 ft. from ground	Height tapped. Stem.	Branches.	Total height	Yield. lbs.	ozs.	Remarks.
		f.	ft.	ft.	lbs.	ozs.	
P 1	38 inches ...	33	5	38	2	13	These were bled by the British Guiana method.
P 2	45 ,, ...	28½	8	36½	2	3	
Totals ...	83 ,, ...	61½	13	74½	5	0	
Average ...	41½ ,, ..	30¾	6½	37¼	2	8	
Q 1	38½ inches ...	37	13	50	1	14	These were bled by the Venezuelan method.
Q 2	47 ,, ...	40	7½	47½	2	7	
Totals ...	85½ ,, ..	77	20½	97½	4	5	
Average ...	42¾ ,, ..	38½	10¼	48¾	2	2½	

Report on Experimental Tappings of Balata Trees.

By C. Wilgress Anderson, I.S.O., Forestry Officer.

THE following is a report on the results of experiments made in the tappings of balata or bullet trees (*Mimusops globosa*) to ascertain the comparative yields of balata from these trees when

(1.) Tapped standing in the usual way.

(2.) Tapped felled.

SITUATION OF TREES.

The trees tapped were growing in the forest of the Indian Reservation at Wikki on the right bank of the Berbice River. The soil was a mixture of sand and clay and the land naturally drained. They were approached by the way of the Sari creek from a landing from which a trail had to be cleared through the forest to where the trees were growing.

An Indian benab built on the banks of the creek within an hour's walk of the trees afforded accommodation for myself and the Indian labourers as well as a shelter for storing the latex collected.

LABOUR.

The Indians at the Wikki Mission had, on my arrival there, already started tapping balata trees on their own account in the forests of the Reservation. Aft r some delay in sending for them, I secured the services of four there and of two others from the vicinity above the Mission, all of whom were expert balata "bleeders."

I arranged to pay them by the results of the balata obtained and in addition a daily wage while working as boathands and transporters. I may mention here that labour of any kind is scarce and difficult to obtain on the upper Berbice river.

PERIOD OF YEAR SELECTED FOR TAPPING.

The tappings were made in July last, a favourable time of the year for the tapping of the trees as the latex then usually flows readily. While engaged on the work rain fell at frequent intervals but at no time was the rainfall so prolonged as to interfere with the tappings or to cause loss in collecting the latex. During the dry season no flow of latex is obtainable from the trees.

TAPPINGS.—BRITISH GUIANA METHOD.

Of the twelve balata trees available, six were tapped *standing* with criss-cross excisions at intervals of about 10 inches apart extending half-way round the circumference of the trunks, in the usual way adopted in the colony for "bleeding" balata trees.

VENEZUELAN METHOD.

Six others were felled and tapped prostrate with excisions extending as far as practicable entirely around their trunks at distances of about 12 inches apart. Between these cuts oblique excisions were made so as to exhaust all the latex contained in the bark.

THE LATEX COLLECTED.

The latex obtained from each of the trees tapped was separately measured in imperial pints and parts of a pint. It was found impracticable, under the conditions obtaining, to separately dry the latex collected from each of the trees tapped. It was transported to the open lands at Wikki Mission in suitable vessels where it was poured into a shallow wooden tray prepared for the purpose and dried there by exposure to the heat of the sun. To prevent sticking, the bottom of the interior of the tray was rubbed over with a thin layer of soap.

THE BALATA.

As soon as the exposed latex was sufficiently dried, the balata was removed in the form of thin sheets, each sheet so removed being hung dry-side downwards on a line, under shelter, until the soft under-surface had also become dried. This process was repeated during a period of 9 days when the last sheet was removed from the bottom of the tray. In all, six thin sheets of balata measuring about 6½′ x 2′ were produced in this way which together weighed 55 lbs., including a small quantity of scrap found adhering to the tray. These sheets are excellent specimens of balata. They are quite clean and free from extraneous matter with the exception of the one first taken off, scattered on the surface of which are small particles of chipped bark which could not be removed without loss of latex.

RESULTS OF THE TAPPINGS.—YIELD IN BALATA FROM LATEX.

The results of the tappings have been tabulated in detail on the form attached to this report on reference to which the yields of latex and balata obtained by the two methods of tapping

employed can conveniently be compared. For the reasons explained in paragraph 6, the quantity of balata obtained from each of the trees has not been separately recorded. The yield in balata assigned to each tree on the tabulated form has been calculated in proportion to the yield of latex obtained from it, the value determined of one pint of latex, as derived from the total weight of balata obtained when dried for transport, being 0.7 or 7/10 of a pound avoirdupois of balata. (As worked out the exact figures are 0·699 lbs. = 1 pint).

LOSS OF WEIGHT IN SHRINKAGE.

After transportation from the interior of the colony there is invariably a difference between the weights of the balata as determined at the up country depôt and those registered after the arrival of the balata in Georgetown. This is mostly due to shrinkage in weight by subsequent further drying. In the case of my experiments the shrinkage in weight was found to be as follows :

1. Weighed on 9th August after sufficient drying for transportation, 6 sheets and scrap ...55 lbs.
2. Weighed on 16th September after further drying during transportation and while in town 54 „
3. Weighed on 15th November after being stored in town ... ...52.5 „

Loss in shrinkage of weight ... ... 2.5 „

or 4·54 per cent. of total weight when dried for transportation.

YIELD OF TREES TAPPED STANDING AND TREES TAPPED FELLED COMPARED.

Referring back to the main object for which the experiments were made the results shew that the opinions recently expressed, viz :—"that a far greater yield of balata could be obtained if "the method of tapping trees felled were permitted instead of "tapping them standing, as prescribed by the Crown Lands "Regulations," are obviously erroneous as will best be seen from the following summary* :—

NOTE :—* "It will be observed on reference to the tabulated form that the yields of the trees tapped standing vary considerably, the maximum yield in balata being 7.70 lbs. and the minimum 1.33 lbs. per tree. The average yield of six trees was 5.59 lbs. of balata per tree. Cuts made in the trees two or more days after tapping showed no wound response. The flow of latex from the later cuts being inappreciable, or none at all.

	Lbs. of Balata.
1. Yield ·ef six trees tapped standing with excisions extending half-way around trunks...	33·5
2. Yield of six trees tapped felled with excisions extending completely or nearly entirely around the trunks	21.5
Difference in favour of (1)	12 lbs.

or 36 per cent. gain in balata.

Presuming that the trees if tapped standing around the whole circumference of the trunk would yield twice the amount of latex than when tapped only half-way, the gain in balata would then be as much as 68 per cent. more than that yielded by the felled trees. I may mention here that the Indians employed on the work predicted a smaller return from the trees tapped felled than from those tapped standing. In addition, the felling of the trees involves much more labour, harder work and loss of time, than is required to tap them standing,† with the aid of a rope known as the "vention" or "invention."

WOOD OF BALATA TREES.

Lastly, the felling of the trées would cause great waste of valuable wood, which, were transport facilities available, should find a ready sale.

TAPPING IMPLEMENTS.

So far, the cutlass, in the hands of a trained "bleeder," has proved to be the best implement for the tapping of the trees. I have seen many trees that had been tapped with it on which the excisions were, after a lapse of time, completely healed. The so-called Surinam "safety knife" is crude, clumsy and ill-balanced, not easy to sharpen, and, unless kept sharp, tears the fibrous bark of the balata trees. I had a trial made of one by the Indians, who found it awkward to manipulate while using the rope in the tapping of a tree, It was only found of use for the making of cuts in the bark underneath a felled tree where the space between the ground and the trunk was not sufficient to permit the use of a cutlass.

† A medium sized tree was tapped by an Indian with the aid of a rope, as far up as the branches in twenty minutes.

CONDITIONS AND METHODS OF TAPPINGS SIMILAR TO THOSE USED ON BALATA TRACTS.

In the experimental tappings under report, similar conditions prevailed, and the methods adopted were the same‡ as those employed by labourers working on the balata collecting tracts in the colony. The data here determined may be therefore considered as being fairly representative in every way, of the results generally obtainable by those engaged in the balata industry.

CONCLUSIONS.

From the data obtained from the experiments as recorded in this report, it is clearly evident that the mode of tapping adopted in British Guiana, as prescribed by the Crown Lands Regulations, is in every way the most economical both with respect to the yield of the balata obtained and with regard to safeguarding, as far as possible, the lives of the trees for possible future tappings, while, on the other hand, the Venezuelan method of felling the trees for tapping not only yields a very much smaller quantity of balata, as compared with the British Guiana method, but also involves the destruction of the trees.

‡ Except the felling of the trees, which is prohibited.

Tappings of Balata Trees in the forests around the Sari Creek, a tributary on the right bank of the Parway Creek and within the Indian Reservation at Wikki, Berbice River.

No. of Tree.	Girths of Trunks. Where cut or above Buttresses.	At first branch.	Mean Girths.	Length of trunk tapped.	Yield in Pints of Latex. Trunk.	Stump and branches.	Total.	Yield of dried Balata.	Average surface of bark per tree.	Yield of dried Balata per square foot of bark.	Notes and Remarks.
	ins.	ins.	ins.	ft.	Imperial pints.			lbs.	sq. ft.	lbs.	
	Trees Tapped Standing. ½ Circumference.										
1	99·	Approximate. As deduced from	Measurements of felled trees.	50·	7·5	...	7·5	5·25			All of these trees were tapped with the usual criss-cross excisions extending half-way around the circumference of their trunks and in accordance with the method prescribed by the Crown Lands Regulations.
2	78·			45·	13·5	...	13·5	9·45	288·76= / 2	½ circumference.	
3	101·			45·	6·75	...	6·75	4·73			Girth around buttress, 108 inches.
4	90·			45·	11·0	..	11·0	7·70			Tapped by Indian in about 20 minutes.
5	46·			35·	1·9	...	1·9	1·33			Previously tapped ¾ around at bottom and about half-way around up part of the trunk about 15 years ago. Although quite healed, marks of old cuts still discernible.
6	89·			50·	7·25	...	7·25	5·07			
Total...	503·	...	...	270·	47·9	...	47·9	33·53†			
Mean...	83·8	70·2	77·0	45·	7·98	..	7·98	5·59	144·38	0·03877	These results are from a single tapping of each tree.
	Trees Tapped Felled.									·6192 ozs.	
1	77	66	71·5	36·	3·75	1·25*	5·0	3·5			Tapped with ring-cuts around trunks 10 to 12 ins. apart, with oblique excisions extending between rings.
2	72·	53·	62·5	59·	3·0	1·0	4·0	2·8			Trunk split from fall up to 14 feet from stump. Height of stump 3 ft. above ground.
3	60·5	48·	54·25	33·	3·0	1·5	4·5	3·15			
4	75·	69·	72·	36·	5·2	not tappable.	5·2	3·64			Bark varies from ¼ to ½ inch in thickness.
5	80·	72·	76·	69·	6·3	0.12	6·42	4·49			Trunk hollow throughout, bark about ¼ inch, height of stump 3 feet above ground. Felled evening before tapping.
6	89·	72·	80·5	57·	4·25	1·4	5·65	3·95			Trunk previously tapped up to 20 ft. above ground and about 21 in. around. Stump 3½ ft. above ground. Bark ¾ inch in places to ½ inch thick.
Total...	435·5	380·	416·75	290·	25.5	5·27	30·77	21·53†		(·2048 ozs.)	
Mean...	72·6	63·6	69·46	48·34	4·25	0·88	5,13	3·59	46·63	0·0128	

* Latex obtained mostly from stumps.
The branches were, from the force of the fall of the trees, so broken and smashed as not to be tappable to any extent.
† Decrease in weight of Balata from 55 lbs. 9th August, to 52·5 lbs., 15th Nov.,=4·54 per cent.

Cacao Experiments, 1913.

By J. B. Harrison, C.M.G., M.A., and S. H. Bayley, Superintendent, Onderneeming School Farm.

DURING the four years 1910 to 1913 inclusive the various plots of cacao trees on the manurial experiment-field were either left unmanured, were heavily mulched or were manured each year. The resultant crops have been dealt with in previous numbers of this Journal, the results of the trials in 1912 being recorded on pp. 39—43 of Vol. VII for July, 1912. As, however, with permanent products such as cacao the effects of manuring cannot be regarded as terminating with the years of application, it is necessary to ascertain and record the yields from the various plots during succeeding years. This has been done for 1913, and is in course of record for 1914.

During the year 1913 the returns of wet cacao from the manurial experimental field at Onderneeming School Farm were as follows:—

YIELDS OF WET CACAO OR "PULP" PER ACRE.

		Lbs. per Acre.	
Plots.		*Yields.*	*Probable error: excess or deficit.*
Nos. 1, 4, 7, 11 & 16	No manure ...	1,000	41
Nos. 3, 8 & 13 ...	Heavily mulched ...	1,290	90
Nos. 12 & 18 ...	Sulphate of ammonia only ...	964	77
Nos. 6 & 14 ...	Superphosphate of lime and sulphate of potash ...	1,518	175
Nos. 5, 10 & 15 ...	Superphosphate of lime and sulphate of ammonia ...	1,088	128
No. 9 ...	Sulphate of potash and sulphate of ammonia ...	1,181	128
Nos. 2 & 17 ...	Superphosphate of lime, sulphate of potash & sulphate of ammonia ...	1,259	95

These returns are equivalent—on the assumption that (as in

our large scale determination in 1902) the "pulp" yields 36·6% of its weight of cured cacao—to the following:—

		Cured Cacao: Lbs. per Acre.		
Plots.		*Yields.*		*Probable error: excess or deficit.*
Nos. 1, 4, 7, 11 and 16	...	366	...	15
Nos. 3, 8 and 13	...	472	...	42
Nos. 12 and 18	...	353	...	28
Nos. 6 and 14	...	555	...	64
Nos. 5, 10, and 15	...	398	...	48
No. 9	...	432	...	47
Nos. 2 and 17	...	468	...	35

During the year the mean yields on the mulched plots were somewhat less than on those which had received superphosphate of lime and sulphate of potash. The manuring with superphosphate of lime and sulphate of ammonia and that with sulphate of potash and sulphate of ammonia produced but little increase which, under the conditions of the trials, could be safely ascribed to the previous manurings. A beneficial residual action was indicated where superphosphate of lime, sulphate of potash and sulphate of ammonia had been applied, whilst where the purely nitrogenous manure, sulphate of ammonia, had been applied alone the yields were a little lower than the mean yield of the unmanured plots.

During the five years—1909 to 1913 the totals of the crops of wet cacao were as follows:—

		Wet Cacao: Lbs. per Acre.	
Plots.		*Yields.*	*Probable error: excess or deficit.*
Nos. 1, 4, 7, 11 & 16	No manure ...	5,762	196
Nos. 3, 8 & 13 ...	Heavily mulched ...	7,482	289
Nos. 12 & 18 ...	Sulphate of ammonia only ...	5,440	426
Nos. 6 & 14 ...	Superphosphate of lime and sulphate of potash ...	7,492	460
Nos. 5, 10 & 15 ...	Superphosphate of lime and sulphate of ammonia ...	6,560	485
No. 9 ...	Sulphate of potash and sulphate of ammonia ...	6,208	596
Nos. 2 & 17 ...	Superphosphate of lime, sulphate of potash and sulphate of ammonia	6,801	271

These correspond to the following returns of cured cacao per acre :—

		Cured Cacao: Lbs. per Acre.		
Plots.		*Yields.*		*Probable error : Excess or deficit.*
Nos 1, 4, 7, 11 & 16	...	2,080	...	71
Nos. 3, 8 & 13	...	2,699	...	113
Nos. 12 & 18	...	1,963	...	155
Nos 6 & 14	...	2,705	...	154
Nos. 5, 10 & 15	...	2,375	...	213
No. 6	...	2,242	...	217
Nos. 2 & 17	...	2,465	...	99

These results show that taking into account the probable errors of the trials the highest total yield of cacao during the five years has been on the heavily mulched plots on which there has been a minimum increase of about 435 lbs. of cured cacao or about 84 lbs. per acre per crop over the mean yield of the five non-manured plots. But the cost of the mulching to produce 435 lbs. of cacao, worth say $52, was approximately $66.

On the other hand the application of sulphate of potash and superphosphate of lime, costing approximately $14 during the five years, has given a minimum increase of 400 lbs. of cacao, worth, say $50.

The quick-acting nitrogenous manure used—sulphate of ammonia—somewhat lessened the yields both when applied to otherwise unmanured land, and when added to manurings of superphosphate of lime and sulphate of potash.

The application of lime to the land has not had any beneficial effect, the weight of wet cacao produced on the 18 plots of limed land during the five years having been 6,503 lbs. per acre as compared with 6,574 lbs. per acre yielded by the 18 plots of not-limed land.

EFFECTS OF REDUCING THE DENSITY OF SHADE.

Between November, 1900 and May, 1902 the shade-trees on the cacao fields were largely removed. On an area of about two acres of one of the southern fields the shade-trees were not cut out. At the same time the methods of cultivation were changed and instead of the haphazard want of system that was in force prior to the cacao fields coming under the control of the Agricultural Department the fields have since been

carefully cultivated, the trees pruned, and a persistent look-out kept for pests of various sorts. Under these conditions the returns have greatly increased. The yields steadily increased from a mean annual yield of 1,064 lbs. during the five years prior to the thinning of the cacao trees and during the past five crops at the following rates :—

		Cured Cacao.
		Lbs.
1909	...	4,774
1910	...	5,582
1911	...	4,970
1912	...	4,451
1913	...	4,945
	Mean	4,944

The mean annual increase of 3,880 lbs. of cured cacao was due to the three factors of lessening the shade, adequate tillage and care of the cacao trees, and improved drainage. Until the increase became fairly constant it was, of course, not possible with any approach to reliability to differentiate the effects due to lessening the shade from those of the other factors.

The yields having approached a fair degree of constancy—the falling-off in 1912 being due to the drought of 1911-1912—a commencement was made in January 1913 to determine the results due to the lessening of the shade as apart from the other improvements. This is being done by recording the yields of cacao from the area on which the shade-trees were not thinned out, and from the adjacent parts on the cacao field on which the shade-trees had been largely reduced. Four hundred and fourteen cacao trees are growing on the former and 586 on the latter.

The returns from the heavily shaded and the lightly shaded areas were at the following rates :—

PER ACRE OF 300 TREES.

		Number of Pods.		*Pounds of Pulp.*
Heavily shaded	...	5,889	...	1,204
Very lightly shaded	...	9,546	...	1,823

The yield from the very lightly shaded areas was at the rate per acre of 3,657 pods and 619 lbs of pulp, equivalent in round figures to 2 cwt. of cured cacao in excess of that from the heavily-shaded part.

The mean annual increase of cured cacao per acre from 1910 to 1913 over that for 1897 to 1900 has been, in round figures, 3,800 lbs. This was the increased product of 3,186 bearing trees of which 413 were heavily shaded. Three hundred trees not shaded would have given an increase of 349 lbs. or, say, 3½ cwt. of cacao per acre.

These details indicate that the increased yields may be due to the various treatments in the following proportions :—

	Dry Cacao per acre.
To removal of shade	2 cwts.
To improvements in cultivation and drainage	1½ „
	3½ cwts. per acre.

The experiments have indicated that in British Guiana under conditions similar to those existent at Onderneeming farm, the methods of cultivation precedent to the successful growth of cacao are :—

1. The reduction of "shade" to the lowest amount compatible with due protection from wind.

2. Deep and efficient drainage, certainly not less than from 3 to 4 feet.

3. Annually forking the land between the trees in such a manner as not to injure their roots more than is absolutely unavoidable, whilst effectually loosening the soil for æration and drainage and thus constantly adding to the depth of tilled surface soil and the feeding area available for the roots of the trees. To do this requires the services of skilled forkers working under strict supervision.

4. Mulching the soil, but only so far as can be done at a low cost per acre.; such cost not exceeding, say, $6.

5. Manuring the trees with a mixture of superphosphate of lime and sulphate of potash. The cost of such application should not exceed $4 per acre.

The results of the experiments carried on from 1903 to 1913 point out that in future trials attention should be directed towards a comparison of manurings with phosphates and potash, with and without heavy mulchings, and of heavy mulchings without manuring.

The Crops on the Experimental Sugar-Cane Fields, 1913.

By Professor J. B. Harrison, C.M.G., M.A., F.I.C., Director C. K. Bancroft, M.A., F.L.S., Government Botanist, and R. Ward, Agricultural Superintendent, Department of Science and Agriculture.

The crops grown on the Experimental Sugar-cane Fields were reaped in December, 1913, and January, 1914. The general results of these crops are shown in the following notes :—

THE RAINFALL.

The rainfall during the year 1912, and during the year 1913, as recorded at the Experimental Fields, the average monthly rainfalls on them during the year 1901–1912, and the differences of rainfalls during 1913, in excess of or in deficit from the average monthly rainfalls of 1901–12 and those of 1913, are shown by the following :—

RAINFALL IN INCHES.

Months.	*1913.*	*1912.*	*Averages 12 years 1901-1912.*	*Differences of 1913 from 1912.*	*Differences of 1913 from average of 12 years.*
January	16.67	1.23	6.80	+ 15.44	+ 9.87
February	1.99	.46	5.47	+ 1.53	– 2.48
March	6.34	1.28	9.43	+ 5.06	– 2.09
April	1.74	6.21	7.70	– 4.47	– 5.96
May	4.10	9.08	12.02	– 4.98	– 7.98
June	10.82	8.21	11.80	+ 2.61	– 2.98
July	13.91	11.24	10.19	+ 2.67	+ 3.72
August	6.03	8.17	7.29	– 2.14	– 1.16
September	3.22	1.57	3.94	+ 1.65	– .74
October	3.47	1.89	2.39	+ 1.58	+ 1.08
November	2.27	4.03	4.71	– 1.76	– 2.44
December	15.91	16.45	10.65	– .54	+ 5.26
Totals ...	86.45	69.82	92.39	+ 16.63	– 5.94

The year was characterised by heavy rains in the month of January, a continuation of the heavy rainfall (12.58 inches) of December, 1912. February was a dryer month than was desirable ; the rainfall in March was seasonable ; April and May were dryer than desirable in the interests of the sugar-cane crop ; the rainfall during June, July, August, September and October was seasonable and satisfactory ; November was

dryer than desirable, whilst the rains in December were somewhat too heavy. On the whole the amount and distribution of the rainfall was satisfactory and such as to ensure favourable growth.

The whole area of the sugar-cane fields having been reaped in December, 1912, it was not feasible to cut any canes in May or June, 1913.

YIELDS OF VARIETIES.

The yields of varieties may be conveniently compared with those of Bourbon canes growing on land which had been rested from Bourbon for several years. The average yields and characteristics of the expressed juices of the varieties under the various conditions of manuring used in the large plot series of trials were as follows :—

		JIUCE.		SACCHAROSE IN JUICE.	
Variety.	*Tons Canes per acre.*	*Per cent. of Canes.*	*Specific Gravity.*	*Lbs. per gallon.*	*Tons per acre.*
D 721 ...	31.3	69.6	1.0787	1.793	3.62
D 118 ...	24.2	67.8	1.0846	1.986	2.98
D 625 ...	24.9	72.0	1.0769	1.728	2.91
D 167 ...	24.1	68.4	1.0787	1.833	2.79
D 317 ...	25.0	66.7	1.075	1.792	2 78
D 651 ...	21.5	71.0	1.0795	1.884	2.66
D 246 ...	20.9	68.2	1.079	1.895	2.50
D 420 ...	22.5	67.3	1.0785	1.575	2.49
D 4397 ...	22.9	68.9	1.071	1 642	2.42
D 44 ...	22.8	65.4	1.0755	1.728	2.40
D 642 ...	19.4	73.4	1.0735	1.778	2.36
D 433 ...	22 3	66.3	1.080	1.715	2.35
D 490 ...	20.1	68.6	1.076	1.798	2.31
D 398 ...	19.2	68 7	1.0717	1.695	2.09
D 333 ...	18.2	66.9	1.079	1.848	2.08
D 4399 ...	18.9	66.8	1.074	1.704	2.00
D 639 ...	16.5	68.2	1.0705	1.634	1.89
D 419 ...	16.0	68.3	1.0815	1.798	1.82
D 405 ...	19.5	59.4	1.072	1.676	1.81
D 335 ...	15.5	71.9	1.0775	1.754	1.81
D 305 ...	16.7	66.4	1 072	1.689	1.74
D 426 ...	16.1	67.1	1.0765	1.692	1.70
D 454 ...	12.9	67.4	1.0777	1.334	1.48
D 145 ...	13.5	62.2	1.082	1 952	1.47
D 154 ...	13.9	67.0	1.074	1 839	1.45
Bourbon ...	11.2	68.7	1.0793	1.865	1.36
D 139 ...	12 2	67.3	1.0715	1.694	1.30
D 338 ...	7.0	71.0	1.0735	1.806	.83

Of more direct interest to planters are the relative yields of the varieties under what may be considered as normal nitrogenous manuring for British Guiana—300 lbs. of sulphate of ammonia per acre :—

VARIETIES : YIELDS, SACCHAROSE IN JUICE.

Normal Manuring.

Variety.	*Tons Canes Per acre.*	*Saccharose in Juice. Tons per acre.*
D 721	38.4	4.64
D 118	25.7	3.18
D 625	28.1	3.30
D 167	25.8	2.98
D 317	28.1	3.12
D 651	25.0	3.08
D 246	24.0	3.00
D 44	27.6	2.92
D 490	24.5	2.81
D 4397	26.5	2.80
D 642	21.7	2.74
D 420	23.9	2.65
D 398	21.8	2.37
D 433	22.5	2.37
D 638	19.0	2 33
D 335	19.7	2.31
D 305	20.7	2.17
D 4399	21.9	2.16
D 426	20.4	2.14
D 333	17.0	2.08
D 405	21.5	2.00
D 419	14.3	1.63
D 454	14.2	1.63
D 154	15.7	1.57
D 139	14.2	1.49
Bourbon	12.1	1.47
D 145	12.7	1.42
D 338	8.2	.94

D 118 as in 1910, 1911 and 1912 gave satisfactory results. On the soil of the Experimental fields it is a cane of high resistant power to drought resembling in this respect D 145.

As in 1910, 1911 and 1912, the results of growing D 625 under identical conditions of manuring in rows six feet and five feet apart respectively, were of interest. The mean results were : —

6 feet rows	... ...	24.0 tons of canes per acre.
5 feet rows	... ...	25.7 tons of canes per acre.

The mean yield on the 6 feet row during the four corps was 24.0, on the 5 feet rows 27.8 tons of canes per acre; it is thus clearly advisable on the heavy soil of the Experimental cane-fields to plant sugar-canes in rows five feet apart rather than 6 feet.

AVERAGE YIELDS 1910-1913.

The following shows the average annual yields of the expressed juices of the varieties in tons of saccharose per acre under normal manuring and as mean results of various manurings during the four years 1910 to 1913 :—

		TONS OF SACCHAROSE PER ACRE.	
Varieties.	*Parent.*	*Normal Manuring Yields.*	*Mean Yields.*
D 118	D 625	3.89	3.69
D 625	Dyer	3.32	2.98
D 721	Bourbon	3.21	2.69
D 419	D 625	3.12	2.66
D 167	D 625	3.03	2.45
D 642	Bourbon	2.82	2.41
D 651	,,	2.76	2.27
D 317	,,	2.56	2.35
D 44	D 625	2.41	1.98
D 145	Red ribbon	2.36	2.44
D 398	D 95	2.24	1.87
Bourbon	...	2.20	1.99
D 338	Bourbon	2.15	1.81
D 420	D 625	2.14	2.29
D 405	,,	2.14	1.96
D 638	Bourbon	2.14	1.73
D 4397	,,	2.07	1.64
D 333	D 625	2.06	1.13
D 433	D 1087	1.92	1.84

D 118, D 721, D 419, D 167, D 642, D 651 and D 317 appear worthy of extended trials on the large scale.

D 721, a cane which we considered originally to be of high promise but which for many years gave unsatisfactory yields, has during the past four crops regained the place it formerly held in our estimation.

EFFECTS OF MANURING.

NITROGENOUS MANURES.

The beneficial effects of these manures were, as always, clearly apparent with all the varieties under trial. The mean

returns on 39 varieties as ratoon canes with normal and high manurings—300 and 450 lbs. of Sulphate of Ammonia per acre respectively—were as follows:—

TONS OF CANES PER ACRE.

Fields.	*No Nitrogen.*	*Normal. Nitrogen (60 lbs.)*	*High. Nitrogen (90 lbs.)*
North West ...	12.7 ...	23.4 ...	...
South	8.8 ...	14.3 ...	19.0
North East ...	13.4 ...	23.8 ...	26.7
Mean of South and North East Fields	11.1 ...	19.0 ...	22.5

The meteorological conditions during the year enabled the sugar-canes to make satisfactory use of the nitrogenous manures.

In 1912 on the South and North East fields with ratoon canes 60 lbs. of nitrogen produced 5.7 tons of sugar-cane whilst 30 lbs. more nitrogen only caused an addition of 1.5 tons; in 1913, 60 lbs. of nitrogen produced 7.9 tons of sugar-canes whilst 30 lbs. more nitrogen produced an increased yield of 3.5 tons.

VARIOUS SOURCES OF NITROGEN.

The comparison of the action of nitrate of soda and of sulphate of ammonia applied in equivalent proportions of nitrogen—60 lbs. per acre—gave the following mean results:—

TONS OF CANES PER ACRE.

Fields.	*No Nitrogen.*	*Nitrate of Soda.*	*Sulphate of Ammonia.*
South	8.8 ...	15.5 ...	15.7
North East ...	12.6 ...	18.2 ...	24.1
North West ...	12.8 ...	17.1 ...	22.8
Means	11.4 ...	16.9 ...	20.9

As usually has been the case, the value of the nitrogen in nitrate of soda proved lower than that in sulphate of ammonia. This, doubtless, is due to the heavy rainfalls soon after the application of the manures. The opposite was the case in 1912 when owing to the meteorological conditions the nitrogen of nitrate of soda proved to be more effective as a manure than did that of sulphate of ammonia.

The comparisons on South field as to the relative action of nitrate of soda and of sulphate of ammonia in soils for some years continuously manured with these substances were as follows :—

	TONS OF CANES PER ACRE.	
	After Nitrate of Soda.	*After Sulphate of Ammonia.*
Nitrate of Soda	14.4 ...	16.5
Sulphate of Ammonia	14.4 ...	16.1
	14.4 ...	16.3

Comparisons of sulphate of ammonia, nitrate of soda, nitrate of lime and nitrolim (calcium cyanamide) as sources of nitrogen when applied in repeated dressings and in proportions in each equivalent to 60 lbs. of nitrogen per acre, were made on the North-west field.

As a check on earlier trials the plots which had been continuously manured with the various nitrogenous manures were left unmanured whilst to the respective formerly non-manured plots the nitrogenous manures were applied. The results were as follows :—

(*a.*) Comparisons of sulphate of ammonia, nitrate of lime and nitrolim; mean results with 16 varieties of canes each in duplicate and triplicate plots :—

TONS OF CANES PER ACRE.

No Nitrogen.	*Sulphate of Ammonia.*	*Nitrate of Lime.*	*Nitrolim.*
12.4	23.1	22.5	22.6

(*b.*) Comparisons of sulphate of ammonia, nitrate of lime, nitrolim and nitrate of soda; mean results with 8 varieties of canes each in duplicate and triplicate plots :—

TONS OF CANES PER ACRE.

No Nitrogen.	*Sulphate of Ammonia.*	*Nitrate of Lime*	*Nitrolim.*	*Nitrate of Soda.*
12.9	23.5	23.2	23.8	18.0

These results generally confirm those of earlier years.

The comparative trials have been made during four years, in two of which the meteorological conditions were very unfavourable to the action of nitrates. The mean results in

the four years during which the trials have been carried out have been as follows :—

1ST SERIES. 16 VARIETIES.

No Nitrogen.	*Sulphate of Ammonia.*	*Nitrate of Lime.*	*Nitrolim.*
15.9	25.4	22.7	22.2

2ND SERIES. 8 VARIETIES.

No Nitrogen.	*Sulphate of Ammonia.*	*Nitrate of Lime.*	*Nitrolim.*	*Nitrate of Soda.*
15.9	25.2	22.5	21.1	19.0

The mean annual increases by the use of 60 lbs. of nitrogen in the various forms have been as follows :—

Sulphate of Ammonia	...	9.4 tons of Canes per acre.
Nitrate of Lime ...	...	6.7 ,,
Nitrolim... ...	...	5.9 ,,
Nitrate of Soda ...	...	4.0 ,,

The soil on which these trials have been made is the heaviest clay soil there is in the Experimental fields. It is clear that on such exceptionally heavy soils sulphate of ammonia is far more efficacious as a source of nitrogen than either nitrate of lime or nitrolim, whilst nitrate of soda is by far the least efficacious.

Dried blood was also tried during two crops (none was available for the other crops). Its results in comparison with the more active forms of nitrogenous manures were far from satisfactory.

NITROGEN WITH POTASH AND PHOSPHATES.

Data have accumulat d of recent years pointing to a possibly injurious action of the soluble salts in manures repeatedly applied to cane cultivation on heavy clay soils. The following mean results of trials of sulphate of ammonia without and with sulphate of potash and superphosphates of lime are of interest :—

		TONS OF CANES PER ACRE.		
		Sulphate of Ammonia.		
	No Nitrogen.	*200 lbs.*	*400 lbs.*	*500 lbs.*
Without potash and superphosphates ...	7·9	13·5	19·0	20·2
With potash and superphosphates ...	9·8	14·5	18·1	19·9

The gains indicated to be due to the nitrogenous manurings are :—

	TONS OF CANES PER ACRE.		
	200 lbs.	*400 lbs.*	*500 lbs.*
Without potash and superphosphates	5·6	11·1	12·3
With potash and superphosphates	4·7	8·3	10·1

The results are in accordance with those of former normal years and are the reverse of those obtained in the year of abnormal drought and concomitant short period of growth, 1911–1912, when far higher yields were obtained on the plots receiving phosphates and potash salts than on those not so treated.

EFFECTS OF MANURING WITH PHOSPHATES.

A large number—upwards of 110—of comparative trials with 17 varieties of sugar-cane with and without Superphosphate of Lime were made. In the majority of those trials increases ensued on the application of phosphates. The mean results are as follows :—

NORTH-EAST FIELD.	TONS OF CANES PER ACRE.	
1st Series 16 Varieties.	*No Phosphates.*	*Superphosphates.*
Plots without nitrogen ...	12·2	13·2
Plots with nitrogen ...	22·5	23·0

N. E. FIELD.

2nd Series. 6 Varieties.	*No Phosphates.*	*Super-Phosphates.*	*Slag Phosphates.*
Plots without nitrogen ...	11·0	13·6	16·4
Plots with nitrogen ...	22·6	23·2	23·8

Numerically the results of applications of phosphates to the varieties used were as follows :—

	No. of Varieties giving	
	Increased Returns.	*No Increase*
Superphosphate of lime ...	12	6
Slag phosphates	4	2

In 116 plots without and with sulphate of ammonia the following accrued :—

	Numbers of Plots. Manured with Superphosphates of Lime. Increased Returns		No Increase.
Without sulphate of ammonia	19	...	15
With sulphate of ammonia	34	...	24
Total ...	53	...	39
	Manured with Slag Phosphates		
Without sulphate of ammonia	6	...	2
With sulphate of ammonia	12	...	4
Total ...	18	...	6

The results of the trials show that the addition of phosphates to manurings produced increases, but these increases were not remunerative.

THE SUGAR CONTENT OF THE JUICES OF VARIETIES OF SUGAR-CANES AND OF NEW KINDS RAISED FROM THEM.

The following shows the mean content of saccharose in the juices of the Bourbon canes and of 9 varieties raised from its seed, determined in 1911, 1912 and 1913 in the large field experiment :—

SUGAR CONTENT OF THE JUICES OF THE BOURBON AND ITS SEEDLINGS.

	Saccharose : Lbs. per Gallon. 1911.	1912.	1913.	Mean. 1911–1913.
Bourbon ...	1·854	1·694	1·865	1·804
D 383 ...	1·856	1·614	1·806	1 759
D 651 ...	1·901	1·542	1·884	1·776
D 642 ...	1·784	1·520	1·778	1·694
D 305 ...	1·792	1·506	1·689	1·696
D 4399 ...	1·708	1·486	1·704	1·633
D 638 ...	1·856	1·337	1·634	1·609
D 721 ...	1·712	1·461	1·793	1·656
D 317 ...	1 700	1·464	1·792	1·652
D 4397 ...	1·520	1·269	1·642	1·477

In 1913, one of the seedling varieties yielded juices distinctly richer in saccharose than was that of the Bourbon, whilst the juices of the remainder were lower in saccharose than was that of the parent kind.

During the three years, 1911-1913, in no case has the average saccharine strength of a Bourbon seedling been equal to that of its parent variety.

In the case of D 625 and varieties obtained from its seed, the results were :—

RELATIVE CONTENTS OF D 625 AND ITS SEEDLINGS.

		Saccharose : Lbs per Gallon.			*Mean.*
		1911.	*1912.*	*1913.*	*1911–1913.*
D 625	...	1.735	1.492	1.754	1.660
D 419	...	1.913	1.668	1.805	1.795
D 118	...	1.855	1.698	1.986	1.846
D 167	...	1.854	1.584	1.834	1.757
D 333	...	1.833	1.525	1.848	1.735
D 420	...	1.709	1.553	1.775	1.679
D 44	..	1.765	1.454	1.728	1.653
D 335	...	1.577	1.552	1.754	1.627
D 405	...	1.662	1.414	1.676	1.584

Here the juices of five of the seedling varieties were richer in saccharose than was the juice of the parent cane D 625, one was nearly similar in strength whilst two were lower.

During the three years, 1911-1913, the average saccharose strengths of four varieties have been higher than that of D 625 two were very similar whilst two were lower.

EFFECTS OF APPLICATION OF MOLASSES TO THE SOIL.

The details of these trials in 1911 and 1912, are given on pages 222-224 of Vol. V for 1912, and pages 123 to 125 of Vol. VI for 1913 of *The Journal.* The results have been negative, the apparent increases, when any, that might have been due to the action of the molasses in the soil being within the limit of the probable errors of the trials.

It has been held that although no beneficial effects were apparent during the years of application of the molasses, if the molasses exerted any favourable effects on the microflora of the soil the results of these would be apparent in later crops.

The trials were therefore extended over the crop of 1913, no addition of molasses being made.

The mean results of the 42 plots in duplicate not cross-dressed and cross-dressed with molasses were as follows :—

	TONS OF CANES PER ACRE.	
	Yields.	*Probable Error: Excess or Deficit.*
Without Molasses ...	15·1	·5
With Molasses ...	13·8	·5

The results do not in any way support the view that molasses exerts an action on crops posterior to those to which it was applied.

From the numerous analyses which have been made of the soil of this field it is estimated to contain 83,900 lbs. of organic matters in the soil of one acre to the depth of eight inches. Two applications of molasses might have increased this amount of organic matter by the following quantities :—

Molasses added.	*Lbs. of Organic Matter added.*
100 gallons each application	1,970
200 „ „ „	3,940
300 „ „ „	5,910

or to the extent of 2·3, 4·7 and 7 per cent. respectively. Our earlier enquiries as to the effect of the varying proportions of humus in the soil of the experimental fields do not tend to our attaching any importance to these small increments.

As in the preceding years the yields on the plots which did not receive any application of nitrogenous manure were apparently reduced by the residues of the molasses applications, those not treated with molasses yielding 9·7 tons of canes per acre, whilst those so-dressed yielded 8·7 tons. That is, the crops on the plots which had received molasses were 89·7 per cent. of those on the not-treated plots.

On 27 duplicate plots manured with sulphate of ammonia the mean yields were 16·6 tons of canes per acre on the plots which had not been treated with molasses as compared with 15.8 tons on plots so dressed the yield on the treated plots being 95·2 per cent. of those of the former.

On six duplicate plots using nitrate of soda as the nitrogenous manure, the molasses-treated plots yielded 14·5 tons of

canes per acre as compared with 16·5 from the not-treated plots equivalent to 87·9 per cent. of the latter.

During the three years over which the trials have extended, the plots treated with molasses have given mean annual yields of 19 tons of canes per acre, whilst those dressed with molasses yielded 18·9 tons. These yields are practically identical and are almost as closely concordant as were the mean results recorded from the plots in 1910 previous to the installation of the trials.

The following shows the yields on the molasses-treated plots during the trials, the yields of the non-treated plots being taken as 100 :—

	1911.	*1912.*	*1913.*	*Mean. 1911–1913.*
No manure	82·2	83·1	85·7	83·7
Phosphates and potash ...	92·9	104·7	91·2	96·3
Sulphate of ammonia ...	111·9	95·9	95·5	101·1
Phosphates, potash and sulphate of ammonia ...	100·0	99·2	94·4	97·9
Phosphates, potash and nitrate of soda ...	101·4	103·2	87·9	97·5

During the trials molasses was applied at three different rates. The following shows the results from the treated plots, those from the corresponding non-treated ones being taken as 100 :—

DIFFERENT QUANTITIES OF MOLASSES PER ACRE.

	1911.	*1912.*	*1913.*	*Mean. 1911–1913.*
No molasses... ...	100	100	100	
100 gallons	101·3	98·4	95·5	98·4 ± 1·2
200 „	96·3	106·8	98·8	101·6 ± 1·4
300 „	110·8	97·8	86·3	98·3 ± 1·4

During the three years, trials have been made with molasses on plant-canes, 1st ratoon canes and 2nd ratoon canes ; whilst the residual action, if any, of the molasses has been determined on 1st and 3rd ratoons. The results referred to the yields of the non-treated plots taken as 100 are as follows :—

Direct Application.

Plant canes	100.8
1st ratoons	103·3
2nd ratoons	107·6

After Effects.

1st ratoons	...	...	91·2
2nd ratoons	...	...	91·1

It is evident that on the heavy clay soil of the Experimental fields—a soil containing a sufficiency of readily soluble phosphoric acid and potash for the needs of the sugar-cane and an ample supply of humus constituents—its sole deficiency from a manurial point of view being nitrogen—the application of molasses is of no practical value, and that in the few cases where its application has been followed by some increase in yield, this may have been due to the small quantities of nitrogen supplied in the molasses. It is economically and agriculturally unsound to supply the soil with from 1,720 to 5,160 lbs. of sugars per acre and not get any increased yield of sugar from the applications.

The results are applicable only to such heavy clay soils as are those of the Experimental fields and may not apply to ligter lands.

TRIALS WITH CHLORINATED LIME.

In 1912, trials were instituted of the partial sterilization of the soil by means of a weak solution of chlorinated lime (bleaching powder.) The details of the application were given on pages 125 and 125 of Vol. VI. of *The Journal* for 1913. The crops of 1912 showed no appreciable effects from the partial sterilization but it was possible that such an effect might become noticeable on the subsequent crop. The results of the 1913 trials did not support this, as the treated plots yielded a lower return of sugar-canes than did the non-sterilized. The results of the trials are shown in the following :—

			TONS OF CAN: S PER ACRE.	
			Not Sterilized.	*Partially Sterilized.*
1912	...	...	22·9	23·0
1913	...	...	12·0	11·2
			17·45	17·1

Hence no advantage accrued by the partial sterilization by means of chlorinated lime of this very heavy sugar-cane soil.

Areas under Experimental Cultivation.

THE following statement shows the areas under experimental *cultivation with various products at the Experimental Fields and* Botanic Gardens, Georgetown; Onderneeming Farm, Essequebo; Marlborough, Pomeroon River; Issorora, North Western District; Christianburg, Demerara River; and Clonbrook, East Coast, Demerara.

Products.	*Acreage*	*Products.*	*Acreage.*
Rubber, Para ...	99	Balata	6
,, Sapium ...	2	Fruit Trees	4½
,, Other sorts	1	Oil Palm	3
Limes	32	Castor Oil	1½
Coconuts	30	Tonka Beans... ...	1½
Coffee	23	Bananas	1
Sugar Cane ...	20	Cotton, Sisal, Ginger Lilies, Carludovica, etc.	1
Cacao	19	Ground Provisions (various)	5 to 10
Rice	7		

Ostrich Feathers.

There is one article which is outside the usual trade categories but lately made the greatest advance in price of all products though it has since fallen. This is the ostrich feather. The production is far from being equal to the demand. The market for it is held in London once a month; there are very few brokers and prices depend so much on the Cape supply that other sources hardly count The South African trade is well organised and in this respect commands a great advantage over other comers. A very likely place to profit by the situation is British East Africa, where the birds are of very fine quality. A start has been made in New South Wales. A bird, worth about one pound at birth, begins to lay at three years of age and yield about 60 eggs a year. The feathers are taken from the age of nine months, and the old plucking has mostly been displaced by a cutting near the skin which causes no pain. Hot, dry land is necessary, but green food must be supplied, and this combination of requirements calls for careful selection.

—Colonial Office Journal, June, 1914.

Leaf Diseases of Hevea brasiliensis.

By T. Petch, B.A., B.Sc., Government Mycologist, Ceylon.

In the Eastern Tropics, the leaf diseases which have been recorded for *Hevea brasiliensis* have been confined to nursery plants and have not caused serious damage. In South America, however, there would appear, from the accounts of different investigators, to be at least one which is more dangerous than those known in the East in that it attacks both old trees and nursery plants.

The fungus which causes the diseases was first described by Hennings in 1904 under the name of *Dothidella Ulei*. The specimens had been collected by Ule in the Upper Amazon Valley, Jurua (Acre Territory), on the banks of the Rio Jurua, Mirum (Acre Territory), and on the banks of the Amazon in the neighbourhood of Iquitos (Peru). Hennings did not give an account of the injuries caused by the fungus. Dr. Huber, however, on the occasion of his visit to Ceylon, stated that it sometimes caused serious damage and defoliated the trees.

Recently, the fungus has been re-described by Griffon and Maublanc, from specimens obtained on nursery plants at Belem. These authors do not consider that it is likely to cause a serious disease. They state that on old trees the injury is doubtless insignificant, and only nursery plants could be seriously injured. Griffon and Maublanc found, on the same leaves as the *Dothidella*, conidia and pycnidia which they regard as stages of that fungus, a discovery which gives occasion for a revision of the known facts relating to the leaf diseases of Hevea in South America.

"KUYPER'S DISEASE."

In 1911, Dr. J. Kuyper described what was considered a different leaf disease of Hevea from Surinam. This disease occurs in three forms. In the first stage, the young leaves, only three to five days old, exhibit sub-transparent, olive green or dark green patches, which are sometimes so numerous that the whole leaf blackens and collapses. In the nurseries, sometimes, every plant is attacked. Hevea leaves grow rapidly and apparently the fungus cannot attack the older tissues. Consequently the disease is, in many cases limited to the original spots, the centres of which turn yellow and fall out, so that the leaf becomes perforated. At the edges of the holes, small black bodies are produced, often in such numbers that they

form a closed ring. This perforation of the leaf is Kuyper's second form. The fungus can also occur on the leaf stalks and stems, where it produces swollen areas which may form canker-like patches ; this is the third form.

The fungus of the Surinam disease was described as a *Fusicladium* and was named *Fusicladium macrosporum* Kuyper. It occurs on both *Hevea brasiliensis* and *H. guyanensis*. Kuyper states that nursery plants are often strongly attacked. Its occurrence is irregular, and that, he considers, may be accounted for by the fact that Hevea drops its leaves twice a year. After the leaf-fall, trees previously seriously attacked often produced sound shoots. For that reason, the injury resulting is small. Weak plants often die, and even six-year-old trees may succumb to repeated attacks. Kuyper advises that old trees which are repeatedly attacked should be removed, that plants which show the second stage should be sprayed with Bordeaux mixture to kill the spores which appear then, and that, in nurseries, upper parts of stems which bear the third stage should be cut off.

From a comparison of Kuyper's description and figures with those of Griffon and Maublanc, it would appear that these authors are dealing with the same fungus. The pycnidia and pycnospores described by Griffon and Maublanc are identical with those described by Kuyper as occurring with his *Fusicladium*, while the conidia of the former authors agree with the *Fusicladium* spores of Kuyper. An exact comparison cannot be made as several essential details are omitted from the descriptions, but the coincidences are so close that there does not seem to be much room for doubt.

More recently, Bancroft has recorded another leaf-disease, from British Guiana. The symptoms were "a spotting of the leaves, followed by an increase in the size of the spots, with the production of dried areas which eventually fall away from the green parts leaving holes in the leaf surface." The disease is said to have been "not particularly abundant."

Specimens of the fungus were forwarded to Kew, where it was considered to be new species, and named *Passalora heveae* Mass. The description of the fungus is not available, but it may be pointed out that *Passalora* is a genus closely resembling *Fusicladium* and only doubtfully distinct from the latter. It would appear probable, therefore, that the British Guiana leaf disease is the same as those of Brazil and Surinam.

The Tropical Agriculturist April 191[illegible]

Meeting of the Board of Agriculture.

A MEETING of the Board of Agriculture was held on May 12th, 1914. His Excellency the Governor, Sir Walter Egerton, K.C.M.G., presiding. There were also present Professor J. B. Harrison, C.M.G., Chairman, the Hon. C. Clementi, M.A., F.R.G.S., (Government Secretary), Mr. C. K. Bancroft, M.A., F.L.S., (Deputy Chairman), Col G. C. de Rinzy, Dr. E. P. Minett, D.P.H., Hon. F. Fowler, and Messrs. J. J. Quelch, B.Sc., C. Shankland, Wm. Hodgson, H. L. Humphrys, J. Junor, T. Earle, J. F. Waby, W. M. Payne, A. Seton-Milne, M.R.C.V.S., (acting Government Veterinary Surgeon), R. Ward, W. E. Augustus, and E. S. Christiani, (Secretary.)

The Chairman announced the appointment of the Hon. C. Clementi, Dr. E. P. Minett, Col. de Rinzy and Mr. J. F. Waby, as members of the Board. He also announced that leave of absence had been granted to Mr. G. E. Bodkin, Government Economic Biologist (who during his absence would represent the Board and the Colony at the Congress of Tropical Agriculture to be held in London) and to Mr. W. M. B. Shields. The Hon. J. Downer had returned from leave.

AGRICULTURAL CENSUS.

Professor Harrison laid over the following report on the census taken of agricultural products for 1913-14 :—

Rice,	1912-13,	41,924	acres ;	1913-14,	33,889	acres ;	decrease 8,035 acres.
Coconuts,	,, ,,	13,698	,,	,, ,,	14,177	,,	increase 479 ,,
Cacao,	,, ,,	1,983	,,	,, ,,	1,863	,,	decrease 120
Coffee,	,, ,,	2,896	,,	,, ,,	3,166	,,	increase 270 ,,
Rubber,	,, ,,	3,139	,,	,, ,,	4,018	,,	,, 859 ,,
Limes,	,, ,,	739	,,	,, ,,	941	,,	,, 202 ,,
Sisal,	,, ,,	250	,,	,, ,,	250	,,	,, ... ,,
Maize, Ground Provisions, etc.	,, ,,	18,623	,,	,, ,,	17,580	,,	decrease 1,043 ,,
Horses,	,, ,,	1,047		,, ,,	964		,, 83
Mules,	,, ,,	1,741		,, ,,	1,778		increase 37
Donkeys,	,, ,,	5,777		,, ,,	6,064		,, 287
* Cattle,	,, ,,	66,086		,, ,,	72,237		,, 6,151
Buffaloes,	,, ,,	64		,, ,,	74		,, 10
Sheep,	,, ,,	16,438		,, ,,	18,408		,, 1,970
Goats,	,, ,,	11,747		,, ,,	14,031		,, 2,284
Swine,	,, ,,	14,116		,, ,,	13,942		decrease 174

* Exclusive of the cattle on the hinterland savannahs; which is estimated at 9,000 head.

CULTIVATION OF PARA RUBBER.

His Excellency said that since Mr. Bancroft had arrived he had done what he expected he would do. His reports proved that Para rubber would grow as well here as it did in the Malay Peninsula and Eastern countries and its growth had so far proved a great success.

COCONUT PALM PEST.

Professor Harrison said Mr. Bodkin had compiled a very useful note on the "Control of the Coconut Palm Pest." In Georgetown it had been recurrent for the last twenty years.

His Excellency remarked that so far as he could see not a single occupier had taken the trouble to prevent the spread of this pest of coconut trees.

GRANTS-IN-AID TO VILLAGE SHOWS.

Professor Harrison reported that applications had been received from the West Bank Farmers' Association and the Victoria-Belfield Agricultural Society for grants-in-aid of agricultural shows this year. Mr. Payne had asked certain questions which had been answered

Mr. Payne having stated that in his opinion the shows were useless, moved that the amounts applied for be not voted.

Professor Harrison said that he would like to deal with the question of agricultural instruction generally on the East Coast. He had found the district a very expensive one to look after last year they spent $784. He did not quite agree with Mr. Payne that the shows were useless but believed at the same time they could be made far more useful. In order to do that he wanted to modify the system under which they had been working. He would suggest that an Agricultural Officer be stationed at, say, Belfield, and have under his charge a definite area to look after. He thought that if this was done that a marked improvement would result.

Mr. Payne's amendment on being put to the vote, was lost, and the amounts voted.

The proposal to station an Agricultural Instructor on the East Coast was moved by the Chairman, seconded by Mr. Bancroft and adopted.

ONDERNEEMING FARM.

Professor Harrison, referring to a report on the Onderneeming Farm, said that the quarterly returns from September, 1913 to March, 1914, showed a net profit of $1,160.10.

LIVE STOCK SALE.

With reference to the Live Stock Sale, Professor Harrison said that the sale was largely spoilt by the heavy rains. They had the pleasure of selling a large number of very good animals and the net proceeds were $730.

"JACK GREATLAND, JNR."

Professor Harrison next announced the arrival of the jack donkey, "Jack Greatland, Jnr." The question as to whether the donkey should be sent out into the country, was referred to the consideration of the Live Stock Committee.

MAL DE CADERAS.

Dr. E P. Minett and Col. G. C. de Rinzy were appointed members of the Veterinary Committee.

Professor Harrison said that the Veterinary Committee had, during the last few months, dealt with a large number of cases of *Mal de caderas.* A large number of orders had been issued and he now laid them before the Board for confirmation. The orders were confirmed.

SWINE PLAGUE AND SWINE FEVER.

Swine Plague and Swine Fever were added to Section 2 of Ordinance 4 of 1892, the Contagious Diseases (Animals) Ordinance.

WILD BIRDS.

Professor Harrison reported that permission to export certain specimens had been granted by the Wild Birds Committee to Messrs. H. Y. Delafons.

Micro-Dissections.

An accurate knowledge of the physical state or conditions of living matter has been gained for the first time by the employment of new methods for the dissection of living cells under the highest power of the microscope. Most living matter has been definitely proved to be in the jelly state. In a few kinds of cells the living substance is a liquid. Micro-dissections have thrown new light on the distribution of jellies and liquid in living cells and proved for all time the physical reality of such important structures as chromosomes, nucleoli and spindles. —"Science," June 5, 1914.

Hints, Scientific and Practical.

Partial Sterilization of Soil.

PARTIAL sterilization consists in treating the soil in such a way as to kill some, but not all, of the organisms present, and it is carried out either by heating the soil or by dosing it with mild poison.

The effects of the treatment have been investigated at Rothamsted for some years past, and it has been shown to lead to (1) an increase in the production of ammonia and nitrate, (2) the destruction of many disease organisms and pests, and also of protozoa and organisms detrimental to bacteria, (3) the formation of certain substances not usually present in the soil and (4) a physical improvement in heavy soils. The effect on the plant is therefore to give it a larger supply of nitrogenous food and a healthier medium in which to live; the unusual compounds also have certain effects on quality which, however, are not always very marked. The practical importance of the treatment is that it acts like a dressing of nitrogenous manure, and also enables the grower to deal with diseased or "sick" soils.

--The Journal of the Board of Agriculture (England), May, 1914.

The Sugar Palm.

IN the byways of tropical agriculture there is no more interesting case of neglected possibilities among the major crops than that of the sugar palm *Arenga saccharifera.* This plant, mentioned in Sanskrit writings, is one of the oldest economic species used by civilised man; yet, with the possible exception of a few semi-cultivated plantations in Malaya, there has probably never been a case of using this palm as a major crop under strictly agronomic conditions.

The world has just begun to realize that a deplorable waste of materials in the way of palm sugars has been for a long time a negative fault of modern crop work in the Tropics. India in particular now realizes that very large profits can be made through utilizing the extensive stands and semi-cultivated groves of the wild date (*Phœnix syvestris*) of Bengal, and the palmyra (*Borassus flabelliformis*) of Southern India and Ceylon. In the

Philippines, also, there are four palms capable of greatly increasing the sugar production, though one of these, the coconut is too valuable as a producer of copra, and another, *Nipa fructicans* is likely to be for some time used more as an alcohol crop. The buri (*Corypha elata*) will undoubtedly be held in higher esteem in the future, when the methods of tapping it are better worked out and a way around the difficulty of its late maturity is found.

—The Philippine Agricultural Review, May, 1914.

Millepedes and Centipedes.

MILLEPEDES and centipedes are somewhat alike in general form, and since millepedes are distinctly injurious while centipedes are on the whole beneficial, it is necessary to distinguish clearly between them. The following points will serve for this purpose. Millepedes have *two* pairs of legs to each segment of the body, which (with the exception of the form known as *Polydesmus*) is rounded or cylindrical in form. Centipedes have only *one* pair of legs to each segment of the body, which is somewhat flattened. As regards differences in habbit, millepedes are rather sluggish and when disturbed coil themselves up like a watch spring, while centipedes are active and usually escape by running as soon as they are discovered.

Centipedes are carnivorous and feed mainly on small slugs, snails and insects. The food of millepedes is almost entirely of a vegetable nature. Roots, bulbs and tubers of all kinds are attacked, and when the animals are numerous the resulting damage may be considerable. There is nothing very peculiar in the form of injury produced and the best method of diagnosis is the discovery of the millepedes themselves. In the case of *Julus pulchellus* the animals may often be found in a cavity in the root or tuber, which is gradually eaten away ; occasionally, however they seem to attack the cuticle of the root only, and where the damage takes this form, in potatoes, a type of scab is produced which closely resembles that attributed to "mechanical injury." In the case of an attack of the larger species an examination of the soil near the injured plant, or of any rubbish close by, will usually show which species is responsible. It should be noted, however, that in all cases of attack a certain amount of decay is produced which attracts other enemies, and the identity of the original offender may be thus obscured.

In many cases of damage by millepedes which have been brought to the notice of the Board, there is also evidence of bad cultivation; where high cultivation is practised there is much less likelihood of a serious attack.

Care should be exercised in the use of fresh leaf mould and decaying vegetable matter, which frequently contain these pests.

Millepedes may be trapped by placing just under the ground mangolds, beets, or turnips which have had the interior scooped out. The traps must be examined at frequent intervals and the millepedes collected and destroyed.

Millepedes may be poisoned by soaking pieces of potato, mangold, etc., in a strong mixture of Paris green in water. The baits should be placed near the attacked plants and should be covered with a board, stone, or large leaf to prevent them becoming very dry. It should be noted that *baits so treated are poisonous to man* and *animals as well as millepedes.*

Carbon bisulphide injected into the soil is stated to be a certain remedy, but the treatment is expensive and need only be used where the plants attacked are valuable and the area involved small.

Lime, distributed broadcast and dug in, and soot or soot and water, have been found to be partial remedies.

—The Journal of the Board of Agriculture (England), April, 1914.

The Scientific Investigator.

Probably most of the effective scientific investigation is a result of the fact that some student has taken the time to digress from the beaten paths at various points, and finally he came into regions of unexpected fertility. Love of knowledge, not love of renown, is the ideal incentive for investigation. The ideal investigator is not the man who says to himself "I am going to become an investigator" but rather the man who becomes deeply interested in a subject and is unable to find in the literature the things he is anxious to know. He is thus forced by a desire for more knowledge to become an investigator.

—"Science," June 5, 1914.

The Model Gardens.

Record of Attendances.

Below is given a table, arranged in quarterly periods setting out the number of pupils who attended the Model Gardens of the colony from April 1, 1907. These quarters (recorded below as 1st, 2nd, 3rd and 4th) run from January 1 to December 31. The totals only during 1907, 1908, 1909 and 1910 are given; the records since then are in detail.

Quarters.	Bourda.	Charlestown.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	La Grange, W. Bank, Dem.	Suddie, Essequibo.	Den Amstel.	Houston, E. B.	Wakenaam.	Total Attendances.
1908.										
1st–4th	5,447	3,386	1,477	887	1,053	§160	...	...	...	12,410
1909.										
1st–4th	6,473	2,665	1,738	1,277	1,192	1,897	662‖	...	...	16,904
1910.										
1st-4th	5,026	2,297	3,269	2,348	1,151	1,947	1,984	1,532		19,564
1911.										
First	1,086	360	1,042	838	312	514	414	572	577	5,695
Second	1,263	326	713	816	286	292	536	591	688	5,511
Third ¶	1,093	385	910	627	361	297	543	441	639	5,296
Fourth	1,687	448	935	588	447	406	737	957	540	6,745
1912.										
First	1,127	379	1,374	1,034	425	207	573	359	423	5,901
Second	1,385	359	1,096	900	484	553	730	461	413	6,381
Third	1,416	400	763	889	412	572	621	616	443	6,132
Fourth	1,586	254	1,162	479	459	768	620	720	439	6,487
1913.										
First	1,613	464	1,060	637	529	764	661	464	342	6,534
Second	1,273	498	1,368	863	517	766	653	508	401	6,847
Third	1,176	495	904	670	498	945	736	475	333	6,232
Fourth	1,094	505	1,203	349	451	924	518	389	243	5,576
1914.										
First	1,134	481	1,245	624	564	1,014	475	498	370	6,405
Second	1,047	489	1,008	699	322	726	428	425	263	5,407

Note.—The figures for the Country Model Gardens quoted above refer only to the numbers present during instruction given by the Superintendent Teacher. It has not yet been found feasible to keep reliable, full records of the very numerous attendances during his absence.

¶ Schools in vacation during August.

‖ Instruction commenced in July.
§ Instruction commenced in April.

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest products of the colony exported this year up to June 30, 1914. The corresponding figures for the three previous years are added for convenience of comparison.

Product.	1911.	1912.	1913.	1914.
Sugar, tons ...	30,368	22,337	22,349	32,576
Rum, gallons ...	671,468	1,275,992	1,428,085	1,646,370
Molasses, casks ...	437	906	575	658
Cattle-food, tons ...	2,461	2,417	4,690	1,050
Cacao, cwts. ...	159	102	14	300
Citrate of Lime, cwts.	25·4	0·5	...	21
Coconuts, thousands	472	875	460	1,091
Copra, cwts. ...	746	817	620	820
Coffee, cwts. ...	685	1,147	647	1,756
Rice, tons ...	1,446	2,068	3,338	3,967
Rice-meal, tons ...	491	1,140	1,087	202
Cattle, head ...	472	288	338	623
Hides, No. ...	2,201	1,947	2,421	2,738
Pigs, No. ...	509	629	942	653
Sheep, head ...	21	37	18	12
Balata, cwts. ...	1,670	317	2,300	3,127
Charcoal, bags ...	38,130	37,825	2,8694	36,861
Firewood, Wallaba, etc., tons ...	5,893	5,290	4,312	5,652
Gums, lbs. ...	2,518	2,425	1,515	719
Lumber, feet ...	243,085	99,550	292,233	198,145
Railway Sleepers, No.	2,020	3,876	1,503	2,602
Rubber, cwts. ...	17·3	1·3	·6	6
Shingles, thousands	1,473	819	1,269	1,061
Timber, cubic feet	127,706	142,359	222,929	132,468

JOURNAL

OF THE

BOARD OF AGRICULTURE

OF

BRITISH GUIANA.

VOL. VIII. JULY, 1915. No. 3.

An Explanation.

AT the outbreak of the present war, *the Journal of the Board of Agriculture of British Guiana*, in common with many of its contemporaries, had temporarily to suspend publication. The uncertainty of every prospect and the necessity for economy primarily dictated this course; and we believe our many subscribers and readers will agree that although they themselves suffered, perhaps, some little inconvenience, it was unavoidable in the circumstances. It is now possible to resume publication, and with it to offer an explanation of the delay in the appearance of this number, and an apology. In this issue we shall endeavour to resume the line of work previously carried on and to bridge over the long gap since our last number. By the end of the year we hope to have made up our arrears, and, by completing the tale of the missing issues, to give our subscribers full value for their money The agricultural articles by the Director of Science and Agriculture and the Government Botanist will be resumed in our next number, when the first of a new series on the Cultivation of Limes in the Colony will be commenced. Meanwhile the old features of "The Journal" appear, none the worse, we trust for their temporary eclipse.

Practical Education in Practice.

WITHIN the last year, it has become evident that at last something may be done to bring the system of Education in the Colony more into line with the real needs of the people.. Broadly speaking, the change adumbrated seems to trend towards giving education a practical bias. Thus it has been proposed that the curriculum at Queen's College shall cease to be primarily classical. Within the last twenty-five years, English Public Schools have developed Mathematical and Science sides equal in importance, in many cases, to the Classical section, and even more successful; but Queen's College, owing to lack of funds and the restricted recruiting area for pupils consequent on the limited resources of the Colony, has not been able to make much advance in that direction. With commendable courage the situation has been grasped, and the bold suggestion has been put forward that Queen's shall become, in the near future, a Science School. The change will, we believe, mark an epoch in the history of education in British Guiana.

To the educationalist of the literary type—still the prevailing one—such a transformation will not appeal. To him the study of the Classics is the only true basis of education, and nothing will move him from that position. We would put two suggestions to him: one, that it does not follow—granting that the literary man's thesis has been proved correct in Europe—that the classics are indispensable to the more primitive races of a tropical colony; the other, that the arguments in favour of a classical basis are fundamentally those of the wise old College Don, whose three reasons for the study of Greek were (1) that it enables one to read the words of Our Lord in the original, (2) it gives one a proper contempt for those who do not know the language, (3) it throws open to one positions of emolument for which, otherwise, one would not be eligible. But in British Guiana the lack of an education of the literary type is in reality no bar to success in any walk of life. The restrictions which obtain in Europe in this respect are here practically in abeyance; and the intelligent colonist will conclude that if education is to be given the more it leans to the practical side, the better.

There is a prospect, too, that Primary Education will soon share the same practical tendency, and develop on two diverg-

ing lines—Technical and Agricultural. And in view of all this we would like to draw attention, with some emphasis, to a point which is apt to be overlooked. Practical education means money. Money for apparatus, money for equipment, money for renewals and supplies. A modern English Public School of the first class, with 350 boys, where the principles of practical education have been grasped and conscientiously put into practice, will spend a *minimum* of $5,000 a year on its Science teaching. *Every* Winter-school for the teaching of Agriculture in Holland is fully equipped with apparatus, models of flowers, (as there is, of course, no fresh material available), detailed drawings of fungus pests, models and skeletons of the different types of cattle and horses, and collections of dried cereals and grasses. Now, all these things cost money—much money. Practical education cannot be given unless it is given practically. The technical pupils must have tools to use—for *each* boy to use—until they learn to use them properly. They must have machines to handle ; they must have instruments. Agricultural students must have ground to till, tools to till it with, seeds and cuttings to plant. Unless all these things are provided, practical education must be a failure. Given them, we may hope to see a return as rich as that the Germans are reaping from their wise building up of a great class of skilled workmen. The Germans, to their credit, have never grudged the spending of money in technical education ; and that—often lavish—expenditure, by creating a demand for instruments of precision and complicated machinery, has reacted to produce a body of highly skilled artisans, who in their turn have been able to cheapen immensely the work of their hands. How great an asset these skilled workmen are proving to their country we are having daily demonstrations.

We are aware that to mention the necessary spending of money is not a popular thing to do at the present juncture. The cry is all for economy. But as judicious expenditure is not always extravagance, so the saving of money is not necessarily the best kind of thrift We have had an example recently. The Model Gardens—the result of a scheme suggested in 1903 and most carefully fostered and developed since that date—were summarily abolished by a resolution of the Combined Court in March, 1915. These gardens, which were visited by nearly 22,000 children in 1914, provided the children of Georgetown and New Amsterdam with practically their only opportunities for learning something of the elements of gardening and for

obtaining a liking for such pursuits; they were steadily undermining the prejudices of the children and of their parents against manual labour of the agricultural type; they afforded practical demonstrations of school garden work to the primary schoolmaster and pupil teachers; and the nine of them cost the Colony $2,000 a year. And in half an hour they and the steady work of years were destroyed. The incident does not give much encouragement to the advocates of an enlightened policy of practical education.

A Good and Cheap Whitewash.

The Department of Agriculture of New South Wales recommends the following as a cheap white-wash which will stand the rain and weather without coming off, and will do for galvanised iron:—Place enough tallow required for the purpose in a large bucket; then lay about the same quantity of good lime (dry) on top of the tallow, *i.e.*, equal portions of each; then pour enough water on to slake the lime. When the heat from the lime has melted the tallow, and all is well dissolved, stir it thoroughly until all is well mixed; then apply (warm, if possible) with a large brush. This will do for any surface. The surface must be quite dry before applying the mixture. If required to dry very white, add a small quantity of "blue."

Coconuts and Salt.

The belief that common salt is specially beneficial as a manure for coconuts is not supported by any experiments in the field as far as we are aware. Salt does benefit certain crops; the sodium being able to a limited extent to take the place of potassium especially when there is a deficiency of the latter. It is believed also that salt releases potash in the soil for the use of the plant; but there are, we think no grounds for supposing that coconuts derive particular benefit from salt because of their maritime origin. At Peradeniya the salt plot gave an average of 28·5 nuts per tree in 1913 compared with 28·6 of the potash plot, but it started off with a yield of 54 in 1911; thus declining 47 per cent. The potash plot on the other hand rose from 24·7 to 28·6, an increase of 16 per cent.

—Tropical Agriculturist.

Para Rubber in British Guiana: 1915.

By C. K. Bancroft, M.A., Assistant Director, Department of Science and Agriculture.

In previous papers relative to the cultivation of Para rubber in the colony the growth of the trees in different localities and the estimated cost per acre of bringing an area of 500 acres into bearing have been dealt with.

The latter was shown to be a reasonable amount, under £40 per acre. Recently, other data have come to hand. The experimental tapping, first of 379 trees five-and-a-half years old and later of 300 trees six-and-a-half-years old at Issororo Experiment Station, gives a fair indication of what the cost of collecting the rubber, from trees growing under favourable conditions, will be. The output from 379 trees at Issororo. between November, 1913, and December, 1914, was 597 lbs. of dry rubber, or a little more than 1½ lbs. per tree per annum. The cost of collecting was 16 cents per lb. dry. In the more recent experiment which is now in progress, the output from 300 of these trees from February, 1915, to May, 1915, has been equivalent to 240 lbs. dry. The trees are therefore yielding at the rate of about 2½ lbs. each per annum. The rubber from these latter trees is collected by one man and one boy working each one-third of a day. The cost of collecting is averaging 7 cents per lb. of dry rubber.

These experiments are on a small scale; but they afford *a fair indication that under proper estate conditions it will* be possible to collect at a cost which will allow of a fair margin of profit with Plantation Para Rubber selling on the market at 48 cents per lb.

At Christianburg Experiment Station, on the Demerara River, 250 trees six years old, have recently been included in one experiment. About 112 lbs. of dry rubber have been collected.

THE PROFIT PER ACRE.

The yields obtained from trees growing in various parts of the colony indicate that 300 lbs. of dry rubber per acre can be counted as the return from trees growing on suitable land in a large area in full bearing. This output per acre would therefore, at an average market price of 48 cents per

lb., realise $144 per annum. With a cost of tapping and collecting of, say, 15* cents per lb., the total cost of collecting the output per acre would be $45; and if other charges, *viz.*, management, upkeep, curing, transport, shipping, commissions, &c., amount to an equivalent sum,† the total cost of placing the output per acre on the market would be $90. This would allow of a profit of $54, or £11 5·0 per acre.

Reference has been made above to the conduct of the cultivation under proper estate conditions. By this it is meant that the estate should be laid out in blocks (50 acres is a convenient size for a block), each being under the charge of a driver or foreman who would superintend the tapping, weeding, &c., of the block. Ranges should be in convenient parts of the estate so as to allow labourers to get to work early in the morning. Houses for coagulating the latex should also be placed in different sections of the estate so that the latex may be coagulated before being brought to the factory for rolling, curing, &c.

THE LABOUR FORCE REQUIRED.

One man would be required to tap and collect the latex from at least 300 trees, each having two cuts, before breakfast-time (11 a.m.) To tap the trees on a large rubber estate requires a permanent labour force of about one labourer to three acres. When the estate is in full bearing little attention need be paid to upkeep, since there is little or no weeding to be done; and as the tapping and collecting occupies only half-a-day's work, in order to ensure an adequate supply of regular labour it may be advisable to give out, free of rent or on easy terms, cultivation plots adjacent to the lines.

There are three primary factors in the cultivation of Para Rubber: first the rate of growth of the tree, second the yield of the tree and third the cost of production. In respect to these there is reason to believe—so far as the data at our disposal are concerned—that, providing sufficient labour is available for tapping, the cultivation of this product in the colony should prove successful.

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* This figure is arrived at from consideration of the average output per tree growing in different parts of the colony under favourable conditions and of the number of trees which one man is able to tap in one day.

† On the Eastern plantations it is generally reckoned that the cost of tapping and collecting the rubber is one-half of the total cost of production. In this colony there is every reason to suppose that the same ratio would prevail.

Lessons with Plants in British Guiana.

By the Editor.

"*It is finding answers to questions which chiefly deserves to be called Science.*"—L. C. Miall, F.R.S. in "Teaching and Organisation."

VII.

Readers of "The Journal" will remember that in Vols. V and VI. there appeared a series of articles based on the local Flora, the object being to assist students in their examination of common colony plants and to direct their attention to points of interest or importance from a botanical point of view. Anyone who has attempted to teach "Nature Knowledge" in British Guiana must have been asked by some of his class for a 'text-book' on the subject. Such, at least, has been the experience of the writer: and these articles were written with the idea of meeting that demand. It is the great virtue of Botany as an educational subject in this colony that there is no text-book which can be of any real use to the student; who is perforce thrown back on his own resources and compelled—if he is indeed a student and not a mere candidate for examination—to find out his information for himself. Thus he is introduced to the true method of scientific work, which is essentially heuristic and not a memorising of the results of other folks' labours. At the same time the teacher is well aware that guidance and assistance are very necessary for the student at all times, and especially at the commencement of the subject; and it is hoped that this series of articles will supply this need and so serve the best interests of this department of education. We venture to assert that any one who has conscientiously endeavoured to find out for himself the answers to the questions suggested, and has worked through the specimens dealt with, in detail, will have acquired a facility in observation and a *confidence in his own powers* which will serve him in very good stead—even in the examination room. For examiners, as a class, are improving. It may be mentioned that when the student has acquired at *first hand* the knowledge led up to in these "Lessons" he *will* find an ordinary elementary text-book of Botany some real use to him.

A RECAPITULATION.

As it is some time since the "Lessons with Plants in British Guiana" first appeared in "The Journal" it may not be out of place to recapitulate the chief points touched upon, and to recall to mind the ground covered.

The "Lessons" began with the examination of the Hibiscus; here one of the commonest and most conspicuous of plants; and with the help only of a pair of sharp eyes and a sharp knife the structure of the flower was ascertained and names given to the various parts. Great stress was laid upon the importance of drawing. Some idea of the structure of the stem and root were arrived at—a rudimentary idea, it is true, for to see the details required the aid of a microscope—and the importance of *comparing* various plants of the same natural order was clearly brought out. Thus the student was directed to compare the Hibiscus with the Sorrel, the Ochro, the Cotton, the Silk-cotton and the "Jumbi Ochro," and to note their resemblances and their differences in habit, flowers and leaves. The difficulties of classification are always a stumbling-block to the beginner; and the compilers of text-books seldom give their readers any notion of how simple and inevitable a thing it is. They stick to 'types.' The earliest Botanists were just in the position of our beginner: they examined every flower and plant they encountered: and very soon they were struck by the resemblances between certain forms and their differences from others: and so they "classified" them into various groups. It took some hundreds of years to arrive at our present-day (and still very imperfect) classification: and we can save our student much time by directing him to related plants and so enabling him to grasp clearly the idea of classification. Of the precise value of the reasons for the placing of certain plants in certain families, he cannot expect to be a judge at this early stage of his studies.

MECHANISM IN THE FLOWER.

Having noted the difference between the "herbaceous" stem of the ochro and the "woody" branches of the Hibiscus, we passed on to consider the Flamboyant tree, which is so brilliant an ornament of the streets of Georgetown during the rainy season. We dissected the flower and came upon the idea of a *mechanism* in the flower; some arrangement of its parts which facilitates or ensures more certainly the phenomenon of

pollination—the first step towards the setting of seed. Hints were given to study the correlation of the structure of the flower with the visits of birds and insects, and some examples of such observations and how to record them were given. Some related plants were studied—the Barbados Pride, the Bauhinia —and the idea of a *suppression* of parts of the flower was arrived at. Such modifications are a great source of trouble to a beginner, and it is only by the comparative method of examination that familiarity with the phenomenon and an understanding of it can be gained. In this respect it was pointed out that a study of the Tamarind, the Carrion Crow Bush and the common Cassias was particularly instructive. The three great divisions of the Natural Order *Leguminosae* were hinted at—they will be dealt with more fully later on—and we passed on to a consideration of the "Baby Cucumber," a pretty but pernicious weed, which led us incidentally to the subjects of tendrils and *homology*, and to the notion of "*diclinous* flowers" and "*dioecious* plants." As a family characterised very emphatically by these features, we dealt briefly with some of the commoner members of the N.O. *Euphorbiaceae*, so important in this Colony, and arrived at the conclusion that suppression of the parts of the flower might go so far as to leave the essential organs practically naked. In the sixth article we came to the *Compositae*, the most successful of all flower types. An examination of the sunflower revealed the existence of sterile flowers, specialized with the effect of rendering the great mass of florets forming the 'head' more conspicuous. Attention was drawn to the simplicity but great efficiency of the floral structure—the single ovule in a well-protected ovary; the aggregation of many florets in a head so that one insect can cross-pollinate many flowers and so set a multitude of seeds—but hardly enough stress was laid on the method in which the mechanism works.

THE FLORAL MECHANISM IN THE COMPOSITAE.

If a sunflower be carefully watched, it will be seen that the florets ripen successively from without inwards—*i.e.*, the youngest florets are in the centre of the disc—and that *time* is an important factor in the mechanism. The anthers ripen first and being syngenesious, discharge their pollen into a common 'box' as it were. The style then begins to lengthen and gradually pushes the pollen out of the top of the anther-box. This process may last for 12 hours or more, and during all this time a steady supply of pollen is available for visiting insects to trans-

port to other florets or to other flower-heads. The 'bifid' style, which is covered with hairs on the outside but has the receptive inner surfaces of its two lobes closely adpressed to each other during its action as a piston or brush in the anther-box, now pushes through, the anther filaments wither and pull the anthers back, and the stigmatic lobes curl over and become receptive. Should cross-pollination not occur, the stigmas may bend over so far as to pick up pollen from the hairs on the style below them—pollen from the same flowers, be it noted. Thus fertilization is assured; for even self-fertilization is better than no fertilization at all.

'THE TRIGGER MECHANISM' OF *Thunbergia.*

As an example of a more complicated type of mechanism we may quote the *Thunbergia,* a large and beautiful flower, of two varieties, (white and pale blue) which is common as an ornamental creeper in Georgetown and may be seen in exceptional luxuriance on the Orchid House in the Nursery at the Botanic Gardens. Even a casual observation of the plant will reveal the frequent visits of a big blue bee which alights on the lowest petal lobe and eagerly pushes its way into the throat. After a few seconds the insect emerges with the back of its thorax covered with yellow dust. It will be noticed that this dust is on a part of the insect's body from which it cannot be easily removed—for a bee has as much difficulty in scratching its back 'between its shoulders' as a man has. If the student tries probing a freshly opened flower with the pointed end of a lead pencil he will find that he can 'work' the flower almost as well as the bee; and if he dissects the blossom—and includes in his disection a carefully cut longitudinal section—he will disclose its secret. Careful note should be made of the situation of the 'nectar,' secreted in this case by a thick ring of tissue round the base of the ovary—and of the efficient protection afforded to the store. Anything sweet is exceptionally attractive to animals, especially insects; but it would not benefit the flower if small creatures, not adapted to work the mechanism, were free to rob it. That the big blue bee is exceedingly well fitted for the task will become more and more evident as observation proceeds. It has strength to push its head well into the flower and to force its tongue past the guarding fringe of hairs, while its tongue is long enough to reach the pool of nectar stored in the base of the corolla tube. When the bee visits the next flower, the scoop-shaped stigma scrapes off some of the pollen from the back of the

nsect, but renews the supply from its own bursting anthers But none of this is left on the stigma as the bee retreats. Why will be obvious to the observer.

With these suggestions for an extremely pretty exercise, we leave our readers with the next number of "The Journal," when we hope to deal with some "Monocotyledons."

(To be Continued).

Wedge-grafting.

The Superintendent of the Lucknow gardens recommends recourse to wedge-grafting with scions of the female papaw on the male. This is done by removing the young lateral shoots found on the female after the first year,—especially if the tree has had its top removed, and grafting these on young male plants.

It is necessary that the shoots should be about the same size as the stem of the stock.

—The Tropical Agriculturist, March, 1915.

Papain.

In recent years the papaw has come into prominence on account of the drug papain obtained from the fruit. The usual manner of collecting this is by making light superficial incisions or scratches in the unripe fruit while on the trees, using a bone knife or other non-metallic instrument for the purpose; incisions need not be more than about a quarter inch deep and about half inch apart. The milky viscid juice immediately exudes from the cuts and is collected in porcelain, enamelled or glass dishes; it coagulates naturally, forming a resinous-looking granular mass, and is then dried in the sun. It must be dried rapidly, otherwise it putrifies and gives off an unpleasant sour odor. To obviate this a trace of formalin should be added to the juice when collected. The tapping, i.e., the process of obtaining the juice by incisions, may be repeated at intervals of two or three days, but unless this is done carefully the fruits are liable to wilt and dry up. The early morning is the best time to tap, the flow being then most abundant.

—Tropical Agriculturist (Ceylon), March, 1915

A Preliminary List of the Mosquitos of British Guiana.

By F. W. Urich, Entomologist, Board of Agriculture, Trinidad.

THE following list of Mosquitos was compiled with the assistance of Mr Frederick Knab when the writer was in Washington in 1911. When not otherwise stated the specimens are represented in the collection of the U.S. National Museum.

Forty species for a country like British Guiana is a very small number indeed and shows that much collecting remains to be done. The object of this small list is to put on record in a local publication the species found in the Colony and to call attention to the work that remains to be done.*

Sub-family *Anophelinae.*

1. *Anopheles argyrotarsis*, Robineau—Desvoidy.
   New Amsterdam (Aiken).
   Range.—Trinidad and Martinique.

2. *Anopheles tarsimaculatus*, Goeldi.
   Berbice (Aiken), Georgetown (Rowland).
   Range.—Trinidad, Grenada, Suriname.
   This is the South America form of A. albimanus.

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*We welcome Mr. Urich's article as a contribution towards the knowledge of British Guiana Mosquitos because it contains one or two interesting points. Thus the identifications of *Culex quinquefasciatus (fatigans)* with *C. cubensis* and of *Uranotaenia lowii* with *U. minuta* coincide entirely with the results obtained by our local workers and it is good to have such questions definitely settled. *Haemogogus equinus* occurs as the only addition to the list of mosquitos published in local journals. On the other hand Mr. Urich's list omits a great deal—at least 21 authentic species—and it would appear that the considerable amount of research on British Guiana Mosquitos done since the writer was in Washington in 1911 has escaped the notice of our contributor—possibly because the accounts of it have appeared chiefly in local (British Guiana) publications.—ED. J. B. A.

3. *Anopheles nimba.* Theobald.
(Stethomyia) Mono. Culicid 111, page 62, 1903).
Guiana.
Not in the collection at Washington.

Sub-family *Culicinae.*

4. *Megarhinus superbus.* Dyar and Knab.
Siparuni Creek, Essequibo River (Wise), Georgetow (Moore).
Range.—Trinidad.

5. *Megarhinus haemorroidalis,* Fabricius.
Omai (Wise), Siparuni Creek (Wise).
Range.—Paramaribo.

6. *Aedeomyia squamipennis.* Arribalzaga.
New Amsterdam (Aiken), Georgetown (Aiken.)
Range.—Dutch Guiana.

7. *Bancroftia fascipes,* Coquillet.
(Mansonia.)
Omai. (Wise.)
Range.—Trinidad.

8. *Uranotaenia pulcherrima,* Arribalzaga.
Georgetown (Moore).

9. *Uranotaenia lowii.* Theobald.
= *U. minuta.* Theobald.)
Georgetown (Rowland), Berbice (Aiken).
Range.—Trinidad.

10. *Uranotaenia geometrica.* Theobald.
Georgetown, (Rowland).

11. *Pseudouranotaenia rowlandi.* Theobald.
Mono. Culicid IV, page 566, 1907.
New Amsterdam.
Not in the collection at Washington.

29. *Culex aikeni.* Aiken (not Dyar and Knab.)
=(Gnophodeomyia inormata. Theobald).
Berbice (Aiken).
Sub-family Sabethinae.

30. *Wyeomyia ulocoma.* Theobald.
Mono. Culicid 111, 313, 1903. (Dendromyia) British Guiana.
Not in the collection at Washington.

31. *Wyeomyia luteoventralis.* Theobald.
(*Dendromyia* Mono. Culicid 111, page 318, 1903.)
British Guiana.
Not in the collection at Washington.

32. *Wyeomia quasiluteoventralis.* Theobald.
(Mono. Culicid 111, page 317, 1903.)
British Guiana.
Not in the collection at Washington.

33. *Wyeomyia asullepta,* Theobald.
(Dendromyia) Mono. Culicid, 11 1, page 315, 1903.
British Guiana.
Not in the collection at Washington.

34. *Wyeomyia aporonoma.* Dyar and Knab.
Georgetown (Moore).

35. *Wyeomyia melanocephala.* Dyar and Knab.
Rupununi (Wise).
Range.—Trinidad.

36. *Wyeomyia chresta,* Dyar and Knab.
Georgetown (Moore.)

37. *Limatus durhami.* Theobald.
Rupununi (Wise), Georgetown (Moore).
Range.—Trinidad.

38. *Goeldia fluviatilis,* Theobald.
(Mono. Culicid 111, page 331, 1903).
British Guiana.
Not in the collection at Washington.

39. *Sabethes schausi.* Dyar and Knab.
Omai (Schaus.)

40. *Runchormyia frontosa.* Theobald.
(Mono Culicid 111, page 319, 1903.)
British Guiana.
Not in the collection at Washington.

Coconut Cake and Palmnut Kernel Cake.

Coconut cake and palmnut kernel cake are two feeding stuffs which are being brought prominently to the notice of stock owners as a result of the war. The main reason for this is that part of the large quantity of the raw products from which these cakes are manufactured, *viz.,* "copra" and palmnut kernels respectively, which were formerly exported to Germany and Austria-Hungary, has now been diverted to the United Kingdom. A certain amount of coconut cake is manufactured in England, but hitherto practically all the palmnut kernels produced in Nigeria and other British Colonies have been exported to Germany.

Further, the closing of the German market has made it necessary for such parts of the Empire as depend largely on the export of copra and palmnut kernels to find new markets, and efforts are being made to establish new coconut and palmnut kernel crushing industries in the United Kingdom. The success which might attend the establishment of such industries would partly depend (at any rate during the continuance of the war) on the extent to which the cakes should be disposed of to British farmers, who purchase very large quantities of feeding stuffs, and are always ready to utilise new oil cakes if they can be shown to be good value.

—The Journal of the Board of Agriculture, London, February, 1915.

A Note on the Recent Attack of Brassolis sophorae.

By L. D. Cleare, jnr., F.E.S., Biological Department.

THE Coconut Palms in Georgetown suffered from another attack of *Brassolis Sophoræ* during the past year. In this attack a few points were noticed that seem peculiar and may be noted here. The insect has been previously investigated by Mr. Bartlett in 1905, his report being published in the "Official Gazette" of October 28, 1905, and by Mr. Stockdale in 1908 and an article entitled "A Caterpillar Pest of Coconuts" by him was published in *The Journal* of July, 1909. In this article he gave a popular account of the life-history of the pest.

Brassolis was recorded from the colony as early as 1848 by Schomburgk in his *Fauna und Flora von Britisch Guiana*, but he does not give the food-plant. The present attack was not confined to the coconut palm, the common "Cabbage Palm," *Oreodoxa oleracea*, being also affected.

This pest has been previously recorded from Mahaicony district on the East Coast, from Berbice, and from Onderneeming, Essequebo. It is probable that *Brassolis* is to be found along the entire coastlands. Outside of the colony it is recorded from Dutch Guiana and the Island of Trinidad

A noticeable thing in this attack was the way in which the pest spread. While the exact place of origin is not known observations points to La Penitence or some spot in its vicinity. They then spread from south-west to north-east in direct opposition to the prevailing winds. The insects did not cross the river in spite of the wind being in their favour. This, however, was probably due to their feeble powers of flight. In the same way, Kitty Village remained untouched throughout the whole period, whilst Albert-town, separated from it by but a few empty blocks, was by far the worst affected ward in the city. Although practically the whole of Georgetown was affected, there were blocks in the midst of infected area which remained untouched. Not a single tree in the avenue along the Sea Wall was attacked though the adult insects were observed in this vicinity on more than one occasion.

THE LOSS IN MONEY.

By September the insects had practically disappeared and a census of the dead palms was taken. In the whole town there were counted about one hundred and seven dead palms. It is estimated that there were about two thousand of these palms in the city, so approximately five per cent. (5%) had succumbed to this attack. Since September several other trees have died so that five per cent. can be considered a safe estimate. Some idea of the financial loss caused by this insect can be gained by making some simple calculations. The average age at which a tree begins to bear is about five years; and taking the average return at $1 per tree per annum (this being the usual estimate) the loss of 107 dead trees is $535. To this must be added the loss caused through damage to the remaining nineteen hundred, for they will take eighteen months to recover from their defoliation. At the same rate this would amount to $2,850, making a total of $3,385. This estimate is for the city of Georgetown alone. If the loss in the coconut districts be taken at the same figure the amount would probably be startling.

Fortunately *Brassolis sophoræ* has many natural enemies. The common Kiskadee (*Pitangus sulphuratus*) and many other birds feed on the butterflies, while both the eggs and the pupæ are parasitized. It is only when natural conditions are adverse to these parasites that the pest gains a foothold and causes extensive damage.

The methods of control are simple, and although they have often been repeated they may be repeated once again. The habit the larvæ have of feeding almost exclusively at night and living in 'nests' during the daytime offers the easiest means of control. The 'nests' can be located from the ground and a boy sent up the tree to cut down the leaves bearing them. When the leaves fall to the ground care should be taken to destroy all the caterpillars in the 'nests.' This can be done either by immersing them in a pail containing water and kerosene oil or simply by crushing.

Meeting of the Board of Agriculture.

A MEETING of the Board of Agriculture was held on October 16th, 1914, His Excellency the Governor (Sir Walter Egerton, K.C.M.G.) presiding.

The President said that it had come to his knowledge that Mr. Quelch was leaving the Colony shortly. He thought that in recognition of his many eminent scientific services to British Guiana Mr. Quelch should be asked to become an honorary member.

Mr. Quelch thanked His Excellency and said he would be pleased to accept the honour.

REPORTS.

The following were among the reports submitted :—

Appointment of Mr. A. Seton Milne, M.R.C.V.S., as Government Veterinary Surgeon.

Abandonment by the West Bank Farmers' Association of their Agricultural Show for 1914-15 and the refunding to the Treasury of the amount given towards the expenses of the Show.

Germination of only 630 out of 30,404 seeds of *Elais guineensis*—2·07 %.

Areas under experimental cultivation by the Departmemt of Science and Agriculture :—

	Acres.		Acres.
Rubber, Para ...	99	Fruit Trees	4½
,, Sapium ...	2	Oil Palm	3
,, other sorts...	1	Castor Oil	1½
Limes	32	Tonka Beans... ...	1½
Coconuts	30	Bananas	1
Coffee	23	Cotton, Sisal, Ginger-lilies, *Carludovica*, &c.	1
Cacao	19	Ground Provisions ...	5 to 10
Sugar-cane	20		
Rice	7		
Balata	6		

PLANT DISEASES AND PESTS COMMITTEE.

On the motion of the Chairman, seconded by the Hon. C. Clementi, Regulation 4 of the Regulations relating to the Plant Diseases and Pests Committee was revoked and the the following enacted in its place :—

The Committee shall have the following powers :—

(1.) To carry on all correspondence relative to its duties with the Government through the Chairman or Deputy Chairman of the Board.

(2.) To carry on all other correspondence relating to its duties through the Secretary of the Board.

(3.) The functions and powers of the Board under Ordinance No. 21 of 1903, the Importation of Plant Diseases Prevention Ordinance, 1903.

(4.) (a) To act under the provisions of the following Sections of the Plant Diseases and Pests (Preventive) Ordinance No. 12 of 1914 :—Nos. 3, 4, 5, 6 and 8.

(b) To assess for the purposes of Section 9 the value of any crops, trees or bushes removed or destroyed under any order issued under Section 6.

(5.) Any other duties that may be required in connection with the control of Plant Diseases and Pests.

SPECIFIC PESTS.

It was decided to add to the list of plant pests proscribed the following :—

"Love Vine" (*Cuscuta* spp.)

"Bird Vine" or "Miseltoe" (*Loranthus* spp.) on Para Rubber, Cacao, Coffee, Citrus and other fruit trees.

Orders were adopted for the suppression of Witch-broom of Cacao, Bud-rot of Coconut, *Brassolis sophorae*, and for the disposal of all dying and dead palms.

INSPECTORS.

The following were appointed Inspectors under Section 4 of the Plant Diseases and Pests (Prevention) Ordinance :—

Officers of the Local Government Board :—

The Inspector of Districts.

The Assistant Inspector of Districts.

The Government Medical Officer of Health.

The Government Sanitary Inspectors.

Officers of the Board of Agriculture :—

The Agricultural Superintendent.

The Horticultural Superintendent.

The Government Veterinary Surgeon.

The Agricultural Instructors.

The Agricultural Assistants.

The District Commissaries in charge of the various Fiscal Districts.

The Commissioner, North West District.

The Stipendiary Magistrate, Pomeroon District.

H. W B. Moore, Esq.

NO ANNUAL LIVE STOCK SALE.

The Chairman reported that owing to the small amount of stock available for sale, the Live Stock Committee did not recommend the holding of the usual annual auction sale.

COLONY FREE FROM MAL DE CADERAS.

The Chairman reported that the Colony was free from the equine disease, Mal de Caderas, the animals affected having died or been slaughtered : and that the Veterinary Committee were unable to recommend that compensation be awarded to Plantations for animals destroyed through Mal de Caderas. He moved the adoption of the findings of the Committee : and this was carried.

A licence to kill wild birds was issued to Mr. M. A. de Freitas and permission to export bird skins was granted to Professor Dr. A. G. Ruthven of the University of Michigan, U. S. A.

Meteorological Returns for the Year 1914.

Taken at the Botanic Gardens, Georgetown.

	Temperature.						Humidity.		Sunshine No. of hours daily.	Rain-fall.	Wind.	
	Solar Maximum.	Minimum on Grass.	Shade Maximum.	Shade Minimum.	Range	Corrected Mean.	Midday.	Night.		Amount in Inches.	General Direction.	Average Force.
January ...	148·9	71·5	83·5	74.7	8·8	78·5	69·5	80·1	7·9	1·79	N.E	1·0
February...	148·6	72·6	83·6	75·4	8·2	78·9	71·6	81·3	6·3	2·46	,,	1·1
March ...	149·4	72·0	84·5	74·9	9.6	79·1	64·8	79·0	8·1	2·34	,,	1·0
April ...	148·5	72·9	84·6	75·6	9·0	79·5	70·3	81·1	6·6	4.22	,,	1·1
May ...	139·6	73·2	83·1	75·2	7·9	78·6	80·0	87·5	4·9	18·37	,,	1·0
June ...	143·7	73·5	84·3	75·2	9·1	79·2	74·5	90·3	6·8	9·25	,,	2·0
July ...	143·7	72·4	85·5	74·8	10·7	79·6	71·1	84·4	8·2	5·37	,,	1·1
August ...	149·0	73·0	86·5	75·3	11·2	80·3	67·8	84·8	7·9	4·40	,,	1·1
September	150·0	72·8	86·9	75·6	11·3	80·7	67·4	83·3	8·7	5·18	,,	2·0
October ...	151·4	73·1	87·0	76·3	10·7	80·1	63·9	83·1	8·4	4·80	,,	1·0
November	149·0	72·8	86·4	72·8	13·6	79·0	67·5	87·0	7·2	4·81	,,	1·0
December	146·9	73·1	84·5	76·1	8·4	79·7	72·0	85·7	5·9	6·50	,,	1·0
Mean ...	147·4	72·3	85.0	75.1	9·8	79·4	70·0	83·9	7·2	...		1·2
Total...	...	...	...	...	...	...	...	...	...	69·49		...

Hints, Scientific and Practical.

The Importance of Lime in the Soil.

Mr. Hall, in his presidential address of the British Association in Australia, in referring to the subject of soil exhaustion, indicated the chief factors which influence fertility as rainfall, the physical condition of the soil, and the presence of lime.

He attaches so much importance to the last as to place it first among these factors, inasmuch upon the presence of carbonate of lime in the soils depends the production of available plant food as well as the natural regeneration of the soil.

This important agent being entirely uuder the control of the agricultnrist, there should be no excuse for its absence from our cultivated areas. Our (Ceylon) soils are generally deficient in lime, which however is easily obtainable.

—Tropical Agriculturist, March, 1915.

Preserving Cut Flowers.

Comprehensive experiments carried out by Professors B. M. Gugger and Lewis Knudson at Cornell show, that little, if any, effect is produced on cut flowers by additions of salts. The trials were made with Cosmos, Petunia, Aster, Verbena, Violet, Coreopsis, Dahlia, *Tegetes erecta* and *T. patula*, Geranium, Zinnia, Sweet Peas and Pansies. Many different solutions were tried, including those of calcium nitrate, zinc sulphate, copper sulphate and common salt. Mixtures of salts were also employed. In no case was any striking result obtained, though not infrequently the treated flowers kept a day or so longer than those put into plain water. The fouling of water due to bacterial action, which takes place when certain cut flowers are kept in water, may be prevented by the addition of a trace of zinc sulphate or of copper sulphate. Boiling, burning or mashing the cut ends of the stems—processes which are often recommended—proved useless, but the daily removal of the cut end—as is so commonly practised—was found to prolong the life of the flower.

—Gardeners' Chronicle.

Clean Packing of Rubber.

THE desirability of packing plantation rubber in such a manner as to exclude contamination with wood splinters, dust, etc., has been so frequently discussed, that it is not a little remarkable that so far very little, in a practical way, has been attempted in this direction. Tea, an article which sells down to about 4d. per lb., is carefully packed in lead foil; plantation rubber worth, were in these times, 2s. per lb. is stowed, unprotected, in wooden cases.

Planters should bear in mind the fact that one of the greatest advantages of the plantation over the wild article is that it can—or should—for most purposes be used without washing in the factory. The expense involved in washing and drying rubber at the works is considerable, but quite apart from this, the washing operations undoubtedly affect quality. Experience has shown that a comparison between wild and plantation rubbers, when both varieties have been factory washed, does not necessarily give an accurate idea of the relative value of the two articles. Wild rubber must be washed; plantation, if clean and dry, can, for the manufacture of most goods, be taken straight to the mixing rolls.

There is no reason why *all grades, including earth and tree scrap, of plantation rubber* should not be sent home absolutely clean and ready for use. As a very simple and inexpensive solution of the packing problem I suggest that the cases should contain a loose liner of cloth, simply folded over the top. These cloths could be readily washed and returned with the empty cases or separately. The cloth should be of the type so widely used in rubber works for calendering and wrapping, etc. Well boiled, this type of cloth sheds no "fluff," and the mere fact that it is used all through the factory is sufficient evidence of its practicability in this connection. The cost of these cloth liners would be infinitesimal. I suggest to dealers that they approach manufacturers and offer them (naturally after coming to some suitable arrangement with producers) plantation rubber packed in the manner suggested at, say, 1/16th of a penny per lb. over goods packed in cases in the ordinary way, or alternatively that planters should take the bull by the horns, and send home small consignments put up as indicated. I feel sure they would find it well worth their while.

—India Rubber Journal.

Fungicidal Action of Bordeaux Mixtures.

In order to throw more light upon the general action of copper fungicides, and, if possible, to obtain further evidence in support of conclusions previously reached, experiments have been made to determine the action of copper compounds on plant cells other than those of fungi. The tests were made with broad bean, pea, and mustard seedlings, the root hairs of which provide types of cells comparable with the germ-tubes of fungus spores and the cells of actively growing hyphæ, and with apple leaves.

It was found that in some cases the root hairs were killed, deformed or discoloured as the results of the treatment, while in other instances they appeared to be uninjured. If the injurious action was due to the production of soluble copper by agencies other than the cell itself, the whole root-hair system should have been fairly equally affected instead of showing the extreme variations noted. It appeared, therefore, that living cells with readily permeable walls of the unchanged cellulose type or its equivalent are able to produce and absorb soluble copper from insoluble compounds.

The fate of the organism depends upon the relation between the amount of soluble copper produced and absorbed, and the rate of growth of the organism. This is a significant point in connection with practical spraying, since it explains why there may be at times little check to the growth of a parasite fungus after spraying, especially when the parasite has once gained a footing on the host plant.

Cells with walls of an impermeable character, such as those of apple leaves, possess no such power of solvent action upon insoluble copper compounds. In the case of apple leaves, only when there is injury to the cuticle sufficiently recent for no occlusion to have taken place, or when there is some radical alteration in its nature, is soluble copper produced.

Under changed conditions, cells with normally impermeable walls may become permeable and capable of action upon insoluble copper compounds. The difference in behaviour of apple foliage in summer and autumn would seem to be best explained in this way; and the change in the nature of the cell wall may be attributed to incipient death of the cells preparatory to leaf fall. This explanation accords with the fact that the hairs on the under surface of apple trees (which

are decadent cells) are affected by contact with the copper compounds even in early summer when the epidermal cells (being full of life and vigour) remain unattacked.

It is evident, therefore, that the nature of the cell wall is the determinative factor in the direct action of the cell upon the Bordeaux compounds. It is stated that a comparison of the conclusions now reached with those derived from the previous experiments with cells of fungi shows that two distinct lines of work have led to indentical results.

—The Journal of the Board of Agriculture, London, April, 1915.

Acclimatisation of Live Stock in Brazil.

SINCE it is probably in the State of Sao Paulo that the greatest efforts in the direction of stock raising and the testing of the suitability of various foreign breeds have been carried out, some detailed particulars as to the conditions prevailing in this State may be given.

Themean annual temperature of the State is 64° F., with a maximum in summer of 100° F. and a minimum in winter of about 30° F.; the minimum is rarely found, and cold is not often general but is limited to a few places. Imported animals seem to bear the summer very well, especially when the precaution (which in general) is taken of housing them during the hottest part of the day. Animals are, however, generally imported in winter and are already more or less acclimatised by the hot season. It seems that cold is more to be feared than heat.

As regards rainfall, the danger of the rainy season (in summer) lies rather in the prevalence of insects than in any harm caused directly by rain. In the dry season (winter) there is a lack of good pasturage. The natural pastures of the country are composed of poor gramineous herbage, but these are furthest from civilisation, the pastures of districts nearer the capital being practically all artificial and apparently well suited to fattening live stock. Feeding of newly-imported animals presents no difficulties.

From the point of view of acclimatisation of cattle the most important disease is certainly red-water; an account of the progress in regard to this disease in Sao Paulo may be given

About ten years ago, of an importation of 315 breeding animals from Europe and Argentina only 7 were found to survivê, the rest dying from red-water. It has since been found that the losses among imported animals are much reduced (1) if only young animals (12 to 14 months) are imported, as these have proved to be much more resistant than mature animals; (2) if no pregnant animals are imported, as these abort when attacked and generally succumb; (3) if importation is only undertaken during the *Brazilian* winter (May to September), so that animals suffer less from changes climate; and (4) if immunisation is carried out as soon as possible, either naturally or artificially by the application of a limited number of ticks, or by subcutaneous injection of virulent blood from an animal recently recovered from an attack of the disease.

The mortality among imported animals was reduced to 33 per cent. in 1908, 13 per cent. in 1909 and to 7 per cent. in 1910. The certainty of acclimatisation of imported animals cannot yet, however, be guaranteed.

It has been established that red-water is present on all the stock-breeding farms on the State of Sao Paulo, so that immediate immunisation of young breeding stock imported against the disease is imperative if the animals are not to succumb when they reach maturity. In addition to red-water (*Piroplasma bigeminum*), recent research has shown Anaplasmosis (*Anaplasma marginale*) to be prevalent and to be, if anything, more grave than the former.

The work of Sir Stewart Stockman, Professor Nuttall, and Dr. Arnold Theiler having shown excellent results to be obtained from trypan blue, experiments have been carried out in Sao Paulo, and the results fully confirm the finding of these investigators. As trypan blue does not destroy all parasites the immunity conferred is of a permanent nature. In the injection of virulent blood previous to the use of trypan blue it is necessary, however, to eliminate all *Anaplasma marginale* parasites.

Sir Stewart Stockman states that animals immunised against red-water have an increased resistibility against anaplasmosis. Dr. Arnold Theiler is of opinion that immunisation with *Anaplasma marginale* var. *centrale* is the best method of conferring resistibility against anaplasmosis.

M. L. Misson, the Director of Animal Industry in Sao Paulo, comes to the conclusion that it would be much preferable to carry out immunisation of animals against red-water in Europe some time before embarkation.

The immunisation of animals against red-water is undertaken at the cattle-testing station of the board at Pirbright, Surrey. Through the instrumentality of the Chief Veterinary Officer of the Board more than 300 animals have been immunised in the last few years and shipped to various countries, including Brazil, and reports on the animals after landing in infected countries have been highly satisfactory.

Other than red-water the most frequent enzootic diseases in the country are symptomatic anthrax and antinomycosis in cattle; glanders and a trypanosomiasis peculiar to South America in horses; rabies, and vermicular pneumonia in goats. Cattle plague does not exist, and up to the present, there has been no case of bacteriological anthrax.

To secure the grants given in respect of imported animals such animals, must *inter alia*, be submitted to the tuberculin or mallein tests before shipment. The tuberculin test is also undertaken at the Board's Cattle Testing Station.

—The Journal of the Board of Agriculture, London, March 1915.

Co-operation and Small Holdings in England.

As regards the local Credit Societies formed for the purpose of making short term loans to their members, the report states that at the end of 1913 these Societies numbered 4,533 with 236,860 members, an average of fifty-two members per society. They had a paid-up capital of £597,390 and during the year they made new loans to members amounting to £3,861,000 and recovered loans previously made to the amount of £3,509,000, the amount out on loan at the end of the year being £2,982,600. Their reserve funds at the end of the year amounted to £115,000.

—The Journal of the Board of Agriculture, London, April, 1915.

Answers to Correspondents.

G. S. H.—The specimens submitted for examination are infected with a leaf disease caused by a minute fungus organism known as *Passalora heveæ*, Massee. It attacks both the leaves and young green shoots of the rubber tree, causing in cases complete defoliation of the tree. A description of the disease is given in the Journal of the Board of Agriculture, Vol. VII., No. 1., p. 37.

E. M.—The cacao pods collected from the East Coast, Demerara, are what are known as indurated pods affected with the "witch-broom" disease of cacao.

R. W.—The diseased peppers are attacked by *Colletotrichum nigrum*, Halstead. Spraying with bordeaux mixture is very effective in checking this disease.

E. S.—The cacao pods are attacked by the "brown rot," *Diplodia*. Spraying has proved efficacious in the control both of "black rot" and "brown rot" of cacao pods. As predicted by the Department in 1896.

N. Y. D.—Your rose trees are affected by "crown gall" causing numerous swellings on the roots. You should destroy such plants, avoid the use of large quantities of pen manure, and drain the beds as thoroughly as possible.

E. M. P.—The rice is affected by "blast" caused by a fungus *Piricularia oryzae*. Nitrogenous fertilising is one of the principal conditions favouring the disease. A seed selection by specific gravity, using 1 per cent. copper sulphate solution is recommended.

—C. K. B.

The Value of Manure for Sugar-Cane.

Recent experiments conducted in various parts of Hawaii have shown that plant cane from an unmanured field will yield from 25 to 30 tons of cane per acre whilst by judicious manuring these figures reach as high as 40 to 42 tons per acre, and 4 to 6½ tons of sugar per acre were obtained from the completely manured plots against 3 to 4¼ tons where unmanured.

The Model Gardens.

Record of Attendances.

Below is given a table, arranged in quarterly periods setting out the number of pupils who attended the Model Gardens of the colony from Jan. 1, 1908. These quarters (recorded below as 1st, 2nd, 3rd and 4th) run from January 1 to December 31. The totals only during 1908, 1909, 1910, 1911 and 1912 are given; the records since then are in detail.

Quarters.	Bourda.	Charlestown.	Belfield, E. Coast.	Stanleytown, New Amsterdam.	La Grange, W. Bank, Dem.	Suddie, Essequibo.	Den Amstel.	Houston, E. B.	Wakenaam.	Total Attendances.
1908.										
1st–4th	5,447	3,386	1,477	887	1,053	160	...	...	...	12,410
1909.										
1st–4th	6,473	2,665	1,738	1,277	1,192	1,897	662	...	...	16,904
1910.										
1st–4th	5,026	2,297	3,269	2,348	1,151	1,947	1,984		1,532	19,554
1911.										
1st–4th	5,129	1,519	3,600	2,869	1,406	1,509	2,230	2,561	2,444	23,267
1912.										
1st–4th	5,514	1,392	4,395	3,302	1,780	2,100	2,544	2,156	1,708	24,891
1913.										
First	1,613	464	1,060	637	529	764	661	464	342	6,534
Second	1,273	498	1,368	863	517	766	653	508	401	6,847
Third	1,176	495	904	670	498	945	736	475	333	6,232
Fourth	1,094	505	1,203	349	451	924	518	389	243	5,576
1914.										
First	1,134	481	1,245	624	564	1,014	475	498	370	6,405
Second	1,047	489	1,008	699	322	726	428	425	263	5,407
Third	1,087	481	844	667	451	728	368	369	511	5,506
Fourth	975	535	772	453	536	557	520	351	389	5,098
1915.										
First	1,123	641	1,006	769	4,906	59	593	339	401	5,931

By a resolution at the Annual Session in March, 1915, the Combined Court declined to vote the money for the upkeep of the Model Gardens; which were in consequence cropped and abandoned.

Note.—The figures for the Country Model Gardens quoted above refer only to the numbers present during instruction given by the Superintendent Teacher. It has not yet been found feasible to keep reliable, full records of the very numerous attendances during his absence.

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest Products of the Colony exported during the year 1914. The corresponding figures for the three previous years are added for convenience of comparison.

Product.	1911.	1912.	1913.	1914.
Sugar, tons ...	98,459	77,788	87,414	107,137
Rum, gallons ...	2,595,293	2,382,937	3,260,986	3,489,729
Molasses, casks ...	1,106	1,760	1,187	832
Cattle-food, tons ...	5,556	5,116	6,859	2,426
Cacao, cwts. ...	798	102	505	577
Citrate of Lime, cwts.	56	½	36	99
Coconuts, thousands	1,038	1,042	872	1,890
Copra, cwts. ...	1,415	1,149	1,127	1,690
Coffee, cwts. ...	927	1,293	797	2,105
Kola Nuts, cwts. ...	4	...	1	4
Rice, tons ...	2,538	2,721	7,709	7,090
Ricemeal, tons ...	1,364	2,005	1,802	241
Cattle, head ...	953	497	965	1,172
Hides, No. ...	4,617	4,230	5,106	4,646
Pigs, No. ...	1,148	1,159	1,604	1,303
Sheep, head ...	40	71	40	141
Balata, cwts. ...	10,289	6,296	11,817	9,131
Charcoal, bags ...	72,937	67,573	62,321	67,450
Firewood, Wallaba, etc., tons	9,866	8,759	8,670	10,204
Gums, lbs. ...	4,652	4,958	2,237	886
Lumber, feet ...	327,328	223,751	517,819	254,772
Railway Sleepers, No.	5,432	5,280	11,020	10,627
Rubber, cwts. ...	32	2	11	9
Shingles, thousands	2,500	2,562	2,645	1,806
Timber, cubic feet...	234,003	284,530	437,111	212,418

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest products of the colony exported from Jan. 1 to March 31, 1915. The corresponding figures for the previous years are added for convenience of comparison.

Product.	1912.	1913.	1914.	1915.
Sugar, tons ...	15,252	13,855	17,470	21,259
Rum, gallons ...	902,210	942,333	993,903	1,216,036
Molasses, casks ...	650	505	628	...
Cattle-food, tons ...	1,566	2,830	765	374
Cacao, cwts. ...	5	...	209	187
Citrate of Lime, cwts.	...	...	...	17
Coconuts, thousands	716	263	579	486
Copra, cwts. ...	710	329	490	589
Coffee, cwts. ...	469	509	927	334
Kola Nuts ...	...	...	...	2
Rice, tons ...	1,136	1,181	2,921	3,071
Rice-meal, tons ...	531	705	98	170
Cattle, head ...	141	177	370	196
Hides, No. ...	722	1,549	1,738	753
Pigs, No. ...	242	544	360	267
Sheep, head ...	6	4	6	2
Balata, cwts. ...	212	1,928	2,078	3,289
Charcoal, bags ...	18,544	14,809	22,076	12,939
Firewood, Wallaba, etc., tons ...	2,817	2,191	3,215	1,914
Gums, lbs. ...	446	1,332	...	...
Lumber, feet ...	46,073	66,611	120,190	8,877
Railway Sleepers, No.	1,556	1,503	502	53
Rubber, cwts. ...	1	4	...	7
Shingles, thousands	207	703	254	441
Timber, cubic feet	63,286	124,038	73,184	37,434

Selected Contents of Periodicals.

Capillary Constants and their Measurement.

Militarism and Party Politics.

—Science Progress, January, 1915.

Some Aspects of the Atomic Theory.

The Authocyan Pigments.

The Prevision of Earthquakes.

The Electrical Properties of Conductors at very low Temperatures

—Ibid : April, 1915.

Agricultural Experiment Gardens in connection with Public Schools.

Rejuvenation of Banana Plantations.

—Queensland Agricultural Journal, March, 1915.

Aberdeen Angus Cattle.

Sunflower growing for Seed.

—Ibid : April, 1915.

JOURNAL

OF THE

BOARD OF AGRICULTURE

OF

BRITISH GUIANA.

VOL VIII. SEPTEMBER, 1915. No 4.

A Special Number.

By order of His Excellency, the Governor, we publish in this issue an article on "The Field and Forest Resources of British Guiana"—written originally for, and published by, *The Bulletin of the Imperial Institute* by the Director and Assistant Director of the Department of Science and Agriculture. The article gives so concise a summary of the present condition and future prospects of the colony, and comes from so authoritative a source, that we are sure our many readers, in and out of British Guiana, will welcome the opportunity to study it in the convenient form afforded by *The Journal.* We would direct special attention to the authors' remarks on the possibilities of the sugar industry. It will come as a surprise to many that the readily available land well-suited to the cultivation of sugar-cane in the eastern part of the colony could produce *one million tons of sugar,* whilst there is available land suitable for sugar cultivation in the North West to increase this quantity of 2,500,000 tons a year! It is such facts as these which justify optimism in the future—an optimism modified by the uncertainty of the political outlook. It has been well said that "all the troubles of the sugar planter have been political."

In addition to the article on the resources of the colony, we are able to offer our readers the first of a new series on the "Cultivation of Limes in British Guiana." The importance of

this crop is becoming more and more evident, and the suitability of this colony for the growth of the fruit has already been abundantly proved. Since the previous series of articles appeared in The Journal much local experience has been gained, and the results of this, with many useful hints, are embodied in the contributions by Professor Harrison and Mr. Bancroft.

Lastly, the interesting experiments on the hybridisation of Cotton, commenced in 1902, have been successful in producing a Buck x Sea Island cross *yielding a cotton of long staple* which is of great promise. It is noteworthy that this important result has been brought about by careful *field selection* and was obtained in the F_4 generation. Details are to hand in yet another communication from the Department of Science and Agriculture.

These valuable papers are fittingly presented to our readers *in this* Special Number.

Science and "Refinement."

Another reason for the lack of recognition (of science) is the attitude of the older Universities and the English Public Schools. By them science as a profession is looked upon as one lacking in the essentials of refinement, and there can be no doubt this social stigma has had much to do with keeping able men of good position from entering it. Law and the Church, on the other hand, have always enjoyed high approval, one reason being no doubt that in these professions the ultimate prizes to be gained in after life are vastly superior. They are, however, limited in number, and as Sir William Tilden remarked at the deputation to the Government already referred to, 'a large proportion of able young men who might otherwise take up chemistry as a pursuit are led into the ranks of other professions, especially the Law, in which there are prizes for the few but disappointment for the vast majority.'

—"Agricultural News," Barbados, September 11, 1915.

Science and Education.

By Sir Ronald Ross, K.C.B., M.D., etc.

Two of the best papers read during the Australian Meeting of the British Association were by Prof. John Perry and Prof. H. E. Armstrong, upon the subject of science and education. Both speakers deplored the low place now taken by science in education, and indeed in the State generally. Prof. John Perry says that "the classics ride us like Sinbad's old man of the sea. All over the British Empire a well-educated man cannot become a professional man of almost any kind unless he pretends to know something of one or more dead languages, such knowledge being of no essential value to him. It is something like what the old Test Act imposed upon us; for a hundred and thirty years a British citizen perfectly competent to fill the highest posts could not take upon himself the smallest kind of public work unless he could swear to a certain formula." "The worst of it is that the average boy who has done almost nothing else than Latin and Greek at school gets absolutely no love for the classics; he never reads Greek or Latin after he leaves school." "One of the curses of intellectual England is due to schoolmasters keeping men at school and treating them as boys until the age of twenty-one. They take scholarships as stall-fed cattle take prizes at agricultural shows." "Genius is very common in both countries, but 99 per cent. of it is destroyed by the schools." "Any ordinary citizen thinks himself fit to be a member of the governing body of a school or college, and the disasters due to this belief are worse than what would occur if we gave to such men the command of ships. The ordinary man, especially the parliamentary man, who thinks that the members of a committee on such scientific business ought all to be non-scientific men will jeer at this statement, but it is, nevertheless, fatally true."

THE LITERARY TYPE.

Prof. Armstrong is equally vigorous. "Our schools," he says, "are for the most part in literary hands; and it would almost appear that literary and scientific interests are antagonistic, so unsympathetic has been the reception accorded to science by the schools." "By placing classical scholars in charge (of schools), we seem unconsciously to have selected men of one particular type for school service—men of the literary type; and this type has been preferred for nearly all school posts, mainly

because no other type has been available, this being the chief product of our universities. Such men, for the most part, have been indifferent to subjects and methods other than literary—I verily believe not because they have been positively antagonistic or lacking in sympathy, but rather because of their negative antagonism." "The literary type of man apparently does not and cannot sympathise with the practical side of modern scientific inquiry, because he has neither knowledge of the methods of experimental science nor the faintest desire for such knowledge."......"To improve our system we need to get rid of our blind British belief in 'men of affairs,' especially in the 'man of business' so-called—really the man of commerce—as persons capable of ordering everybody's affairs and everybody's business." "Science must be organised, in fact, as other professions are organised if it is to be an effective agent in our civilisation."

TWO POINTS AT ISSUE.

There are really two points at issue in these papers, first the general British disinclination for scientific work and thought, and secondly, the rejection of science in education. Every one deplores the former defect, but we do not see clearly how it really depends upon the latter. There has grown up an entirely unreal system of education—as unreal as 'the square root of minus one,' but as much loved by some people as is that mysterious entity or non-entity by others. Just as mathematicians make books out of their imaginary quantities, so do schoolmasters try to make men out of theirs—and in both cases the results are apt to be more curious than useful. We would be the last to object to a true classical education; but then that education must always be combined with a scientific one. Unfortunately what the boy really receives is not a classical education at all, but a grammatical one—quite another thing. Nothing is more educative than a knowledge of the masterpieces of literature in all languages; but our youths do not receive any such instruction. It is doubtful whether many of them have ever even read through the Iliad so as to understand the wonderful construction and the wisdom of the great fable which it develops for the purpose of adding wisdom to mankind. This is not taught, but the boy is kept writhing on the gridiron of grammatical difficulties. Even with regard to English literature the masterpieces are not read by the boys in an intelligent manner, but are merely used for philological texts. The result is that few of our young people are even acquainted with the masterpieces of literature, and are certainly ignorant of their beauty and incapable of appreciating it. Thus when they grow up their minds are content with the most trifling fiction

and the most puerile drama. Similarly, even in the teaching of mathematics, our boys are kept trifling in the porch—worrying over permutations and combinations or burrowing into the depths of conic sections, when they should be taken to the top of a mountain and be given a wide survey of the whole field. Thus they too are instructed only in the ground work, and remain for all their lives ignorant of the main meaning and scope of what was intended to have been taught to them. When we add to such negative teaching all the facts of nature discovered laboriously by many great workers, the square root of the sum results in the modern Briton—at least so far as his knowledge goes.

We do not wish to see any branch of knowledge removed from the curriculum. All knowledge is valuable; but we do not wish to see the receptive years of youth wasted upon unimportant knowledge when they might be used for the acquisition of important facts. The real fallacy of the schoolmaster is his supposition that education is valuable chiefly as an exercise and not as an opportunity for laying in stores of information. If this were the case, nothing should be more carefully taught in schools than the game of chess, which is perhaps just as good an exercise in many respects as are mathematics or classics. But the time of youth is short, and the opportunities soon vanish; and the boy kept trifling in the porch is apt, when he becomes a man, to leave it abruptly with some anger in his heart and without ever having entered the beautiful temple within.

SCIENCE PROGRESS.

Germany's Control of its Industry.

The vagaries of the German government under the varying conditions brought about by the great war now in progress are singularly displayed in the permissions and prohibitions incident to the sugar industry since they were first uttered. On July 31, 1914, the export of sugar was prohibited. On September 17 the export was permitted under licence. On October 5 the export was permitted up to 1,200,000 tons; twenty-two days later, on October 27, permission to export up to 1,200,000 tons was cancelled. On February 6, 1915, export under licence was terminated and prohibition was absolute.

—"Louisiana Planter," June, 1915.

The Field and Forest Resources of British Guiana.

By Professor J. B. Harrison, C.M.G., M.A., F.I.C., etc., Director, Department of Science and Agriculture, and C. K. Bancroft, M.A., F.L.S., Assistant Director and Government Botanist.

SITUATION AND EXTENT.

British Guiana lies between latitudes 0° 41'N (source of the Essequebo River) and 8° 33' 22"N. (Punta Playa), has a depth from North to South of about 500 miles, a seaboard of about 270 miles trending in a south-easterly direction, and occupies in the north-east of South America an area approximately equal in extent to Great Britain. It is bounded on the north by the Atlantic Ocean, on the east by Surinam or Dutch Guiana, on the south and south-west by Brazil and on the west by Venezuela.

The colony may be divided broadly into three belts. The northern one consists of a low-lying flat and swampy belt of marine alluvium—the coastal region. This rises gradually from the seaboard and extends inland for a distance varying from 5 to 40 miles. It is succeeded by a broader and slightly elevated tract of country of sandy and clayey soils. This belt is generally undulating and is traversed in places by sand-dunes rising from 50 to 180 feet above sea-level. The more elevated portion of the colony lies to the southward of the abovementioned regions. It rises gradually to the south-west, between the river valleys which are in many parts swampy, and contains three principal mountain ranges, several irregularly distributed smaller ranges and in the southern and eastern parts numerous isolated hills and mountains. The eastern portion is almost entirely forest-clad, but on the south-western side there is an extensive area of flat grass-clad savannah land elevated about 300 feet above sea-level.

AREA AND POPULATION.

There are estimated to be 57,770,000 acres of land in British Gaiana of which only about 2,000,000 acres are alienated from the Crown. The remainder is open for beneficial occupation and it is estimated that of this vast area over 9,000,000 acres are easily accessible. The major portion of the easily accessible area is suitable for the cultivation of many tropical products.

The population is at present estimated to be 304,149 and consists of British, Portuguese, Blacks, and their descendants, East Indians, Chinese, and Aboriginal Indians. The population is distributed among the various races in the following proportions:—

Europeans	14,000
Including 10,000 Portuguese	
East Indians	130,000
Chinese	2,600
Aboriginals	7,000
Blacks	115,400
Mixed and others	35,000
	304,000

The greater proportion of the East Indians are associated with *the sugar estates and with cultivations such as rice on* the coastal lands, while the forest industries and gold and diamond mining are to a large extent carried on by persons of the African race.

CLIMATE.

British Guiana has been at times described as an unhealthy colony. This is an undeserved calumny, as clearly shown by the statistics of mortality of European races other than Portuguese. For those who lead regular lives and do not expose themselves to unnecessary risks the climate is decidedly a healthy one. The coastlands are swept throughout the year with the north-eastern trade winds which add greatly to the comfort vigour and health of those resident thereon.

RAINFALL.

The mean annual rainfall near the coast is about 94 inches and further inland about 105 inches.

The distribution of the rainfall is fairly even: on the coastlands from the month of August to the month of November it is usually drier than at other periods of the year, the precipitation amounting during these months to an average per month of about 2.5 ins. Away from the coast the distribution is more even, and in the forest regions there is no marked dry spell. In the Savannah country of the hinterland, the far interior of the colony, the rainfall is less regular; there the average an-

nual precipitation amounts to 55 inches, the period from November of one year to March the following year being usually very dry.

TEMPERATURE.

The average mean shade temperature at or near the coastlands for the past twenty-two years is 80.0° F. The average mean maximum is 85.1° F. and the average mean minimum 74.9° F. The greatest annual range is about 19° F.

Recent comparative records of air temperature at three representative recording stations,—Georgetown (coastland), H.M. Penal Settlement (Mazaruni River, 42 miles direct from the coastland) and Dada-nawa in the Rupununi district, 280 miles from Georgetown in the far interior of the colony—are shown in the following table:—

Station.	*Average Annual shade temperature.*	*Mean Maximum.*	*Mean Minimum.*
Georgetown	80.4°F.	85.7°F.	74.7°F.
H.M. Penal Settlement..	79.7° „	88.2° „	76.4° „
Dada-nawa	82.6° „	92.2° „	72.3° „

SOIL.

The results of the examinations of the various parts of the colony and of the soils characterising them have shown that it must be divided into three great belts, each of which has its own special economic resources.

The belts are as follows:—

(1.) The alluvial coast belt is an agricultural one of very exceptional fertility, and its soils are probably among the richest and most fertile in the tropical parts of the world. It is well suited for many forms of tropical agriculture.

(2.) The widespread belt of the lower hills and plains is covered with a seemingly inexhaustible forest containing many kinds of trees which yield timbers and other products of commercial value. As far as has been ascertained, its soils are mainly sedentary ones, the decomposition-products in situ of its country rocks, and are of lower agricultural value than those of the agricultural coast belt. It has, however, been shown that on the more promising soils on the lower parts of the belt arboricultural crops such as limes and Para rubber can be successfully grown. The regularity of the rainfall, in these situations, forms an important factor in the cultivation of certain tropical products.

(3.) The savannah belt at present is practically undeveloped, but may in time become a great district for cattle ranching, whilst there are in it belts of alluvial and fluviatile soils of from fair to high fertility upon which many tropical products could be successfully raised.

LAND TENURE AND VALUE.

The principal terms and conditions on which land may be leased from the Crown for the cultivation of permanent crops such as rubber, *citrus fruits, coconuts, etc.,* are:—

No rent is payable during the first five years of the lease, but the lessee pays an annual rent of twenty-five cents an acre from the *sixth* to the *tenth* year inclusive, and an annual rent of eighty cents an acre during the remainder of the lease, and in default of payment of such rent on the day on which the same is due, the lessee in addition, pays interest thereon at the rate of six per centum per annum for each day of such default.

The lessee shall each year plant not less than one twenty-fifth part of the land leased until he has so planted not less than seven twenty-fifth parts of the said land and shall maintain such cultivation in good order to the satisfaction of the Governor-in-Council or of such Officer as may be from time to time deputed by the Governor-in-Council to inspect the cultivation.

During the continuance of the lease the lessee shall pay the sum of two cents (1 penny) a pound for all rubber, balata, or other substances of a like nature, obtained by him from the land, *from indigenous* trees. There is no royalty on produce of planted trees.

The fees payable for obtaining a lease, which must be deposited with the application, as follows:—

Application	$5·00
Survey:—	
Areas up to 500 acres, per acre	30c.
Each acre above 500 and up to 1,000 ..	20 „
Each acre above 1,000	10 „

These charges include labour, cutting lines, etc.

The lessee is also required to pay the cost of drawing up, executing and stamping the lease in Registrar's Office, say $16,20.

For the cultivation of other products no Crown land, unless under special circumstances, is sold or granted but is rented under leases for terms of ninety-nine (99) years or under with a right of renewal, if the condtions attached to such titles have been strictly complied with, for one similar period, subject to a re-assessed rental.

The rents to be charged for such land, will ordinarily be as follows:—

For any area up to 5 acres, $1 per annum.

For areas over 5 and up to 100 acres, at 20 cents per acre per annum.

For areas over 100 and up to 500 acres, at 15 cents per acre per annum.

For areas above 500 acres at 10 cents per acre per annum.

These conditions compare very favourably with those of other tropical countries.

LABOUR.

In 1911 when the last census was taken, 70,922 or 24% of the total population was engaged on sugar estates; the demand for a large supply of labour for the sugar industry has made immigration from India a necessity for its successful operation.

Immigration from India commenced in 1838, but it was not until 1845 that regular immigration recognised by the Government began. From 1901 to 1911 the average annual immigration of East Indians was 2,435. The colony is now divided into Immigration Districts, each in charge of a resident Agent, while the medical care of the immigrants is under the charge of the Medical Department. In addition to Indentured East Indians, the sugar estates employ both East Indians who have served their period of indenture and Blacks. The wages on sugar estates for field operations vary from 1s. to 2s. a day, cane-cutters earning higher wages, 1s. 6d. to 3s. 6d. A day's work, for the indentured East Indian is defined by law as one of 7 hours. Those engaged in the manufacture of sugar earn higher wages, generally speaking from 1s. 6d. to 2s. 6d. per day.

The labour employed in other cultivations consists of East Indians and Blacks with some Aborigines. Wages for men

vary from 1s. 4d. to 2s. per day; women earn 10d. to 1s. 4d. and children 6d. to 8d.

AGRICULTURAL INDUSTRIES.

The chief agricultural industries are sugar, rice, coffee, cacao, coconuts, rubber, limes, and growing "provisions," such as plantains, cassava, tannias, yams, sweet potatoes, etc. Of these the principal exports are sugar and its by-products, rum, molasses and molascuit, rice, coffee and coconuts. Large increases have recently taken place in the exports of coffee and rice.

The front portion of the coastal region is in part occupied by sugar estates, whilst the bulk of the rice is grown upon this section of the colony. Provision grounds are situated at the back of the sugar estates, at the back of the coastal village lands, and on the lower reaches of rivers. Coconuts are grown on the coastal region, whilst cacao and coffee are chiefly cultivated on the river lands in their lower reaches. Rubber is being successfully cultivated on the river lands and also on the slightly elevated tract of country immediately behind the coastal region.

Cattle raising is carried on to a large extent on the very extensive flat pasture-land of the coastal region, and on a smaller scale on the savannahs of the hinterland.

SUGAR.

The sugar cane with its products is the most important of the agricultural resources of the colony. The sugar industry of British Guiana, in common with that of the West Indian Islands and of some other countries, has passed through many vicissitudes during the last quarter of a century. But the industry has fairly well held its own in the face of prices which at times have been so low as to be more or less unremunerative and of seriously lessened yields in places owing to the sugar-cane having become on them subject to disease to an extent not previously experienced. The area of land, about 72,000 acres, under this crop is practically the same as it was eighteen years ago, while the average crops of sugar-products are somewhat higher. In round figures the colony exports in normal years about 110,000 tons of sugar, 3,600 casks of molasses, 2,500,000 gallons of rum, and 12,000 tons of cattle-food prepared from the refuse-products of the sugar-cane. But if scarcity of labour did not stand in the way of the expansion of the sugar-industry, the colony would be able to

produce many times the quantities of sugar-products for which it is now responsible.

Should any certainty arise of sugar continuing to command, as at the time of writing, remunerative prices, a very great extension of sugar cultivation would take place in the colony. It is estimated on very conservative grounds that the readily available area of land well-suited for the sugar-cane cultivation in the eastern part of the colony could produce 1,000,000 tons of sugar, whilst there is available land suitable for sugar cultivation in the North western portions of the colony to increase this amount to 2½ millions of tons a year.

As in many other sugar-cane producing countries, the sugar-cane in British Guiana has suffered much in late years from fungoid diseases. The Bourbon, which was the best variety cultivated and the source of the far-famed "Demerara Crystals," has either developed a certain tendency to disease, or lost to a marked extent the resisting powers to fungoid attacks it once possessed, and thus has fallen off in its yields. When the Bourbon cane first showed signs of tendency to disease, the planters of the colony took the matter seriously in hand, and succeeded in more or less keeping the diseases under control by the adoption of, as far as possible, every precaution that was suggested by the authorities at Kew, or was indicated by their own experience. But they were not as successful as they would have liked to have been, and hence had to resort to attempts to obtaining an equally satisfactory variety from seed, with the result that now more than four-fifths of the area under sugar-cane is in varieties other than the Bourbon.

As far as obtaining varieties which yield more heavily than the Bourbon now does, or which give remunerative crops on land on which that variety has never flourished, these endeavours have been attended with a large measure of success. But a variety which approaches the Bourbon as a source of "Demerara Crystals" has not yet been secured. This sugar does not owe its high reputation solely to the high proportion of sugar it contains, but to its pleasing colour, flavour and especially to its aroma. The first of these has been more or less successfully imitated in "Yellow Crystals" but the latter appear to be unattainable artificially in the perfection which characterises "Demerara Crystals" made from the Bourbon cane. This sugar is a special product of the colony and when made in British Guiana it may be said to be a "vintage" product of the Bourbon cane.

The trials in British Guiana have had for their object securing or producing reliable varieties of sugar-cane from which planters may select kinds to suit their special conditions of soil, rainfall, etc., and this has been more or less successfully accomplished. In the year 1899 only 550 acres were planted in new varieties in the colony, whilst at the present time over 55,000 acres are under them. The records show that certain new varieties of sugar-cane have given over large areas mean results of 30 per cent. higher than the returns obtained from the Bourbon on the same plantations. About 14 per cent. of the area occupied with new varieties are under kinds imported from Barbados, whilst about 85 per cent. are under kinds raised in British Guiana. The most promising varieties up to the present are 208 B. and 147 B., imported from Barbados, and D. 625, Diamond 185, D. 118, and D. 145, raised in Demerara.

The sugar-manufacturing industry has been compelled by economic conditions to become one almost solely for large capitalists and companies. Smaller cultivators pursue the sugar-cane-growing industry with fair success. Cane-farming is carried out to some extent by small proprietors and villagers, and its extension on a mutually profitable basis to the farmers and to the manufacturers is very desirable.

The following tables show the average annual quantities and the values of sugar and sugar-products exported from British Guiana during the quinquennial periods from 1892 to 1911 and the years 1912, 1913 and 1914:—

QUANTITIES.

Period.	*Sugar,* *Tons.*	*Rum,* *Proof gallons.*	*Molasses,* *gallons.*	*Molascuit,* *Tons.*
1892-6	106,257	2,003,885	100,852	
1897-1901	96,542	4,062,034	357,201	
1902-1906	116,859	3,535,057	333,366	6,666
1907-1911	104,961	2,939,623	176,288	8,488
1912*	77,788	2,382,937	176,011	5,116
1913*	87,414	3,260,986	118,699	6,860
1914	107,138	3,489,729	83,197	2,427
Mean	99,565	2,925,055	192,242	5,911

* Crops very adversely affected by the prolonged droughts of 1911 and 1912.

VALUES.

Period.	*Sugar.*	*Rum.*	*Molasses.*	*Molascuit.*
	£	£	£	£
1892-6	1,305,989	135,946	24,965	
1897-1901	1,066,376	189,186	11,070	
1902-1906	1,142,284	107,099	11,070	23,679
1907-1911	1,170,399	134,690	11,447	20,300
1912	1,019,490	126,178	7,494	17,145
1913	1,102,670	204,163	5,020	23,490
1914	1,574,615	231,846	4,284	10,246
Mean	1,179,218	147,699	13,449	20,829

The average value of the products of sugar cane exported annually from the colony for the past twenty-three years has been £1,361,195.

In the nineties two-thirds of the British Guiana sugar were exported to the United States and almost one-third to the United Kingdom, only a small quantity going to Canada: whilst in 1912 and 1913 70% of the sugar was exported to Canada, about 20% to the United Kingdom and 8% to the United States.

RUM.

British Guiana has the largest export of rum of all the West Indian colonies, its export of pot-still rums alone being 12 pr cent. higher than that of Jamaica. The production of rum has been the subject of investigation in British Guiana on scientific lines for many years past, and as far as the production of alcohol from the sugars present in the wash (wort) is concerned it has in many estate distilleries been brought to a condition approaching perfection.

In British Guiana rum is produced by a rapid fermentation extending from 36 to 48 hours by setting up a wash of molasses diluted with water at a density of about 1,060. The wash is set up slightly acid, and in some distilleries small quantities of sulphate of ammonia are added to it in order to supply readily available nitrogenous food for the yeast.

The distilleries are of two types, using either pot or vat. stills, or Coffey and other continuous rectifying stills. In 1914 there were 27 distilleries of the first type and 9 of

the second. The Coffey or continuous rectifying stills used are of well-known types and are usually built locally, their columns being constructed of colony-grown timber.

Demerara rum is the product of a pure yeast fermentation, and hence does not possess a high flavour like rums of slower fermentation, where wild yeast and bacterial organisms flourish in the wash.

MOLASCUIT.

About a dozen years ago Mr. George Hughes, F.C.S., introduced a process for the preparation from the by-product of the sugar-cane of a high grade cattle food, especially suited for the rapid fattening of beasts. The food consists of a mixture of the finer particles of the interior spongy tissues of the sugar-cane, which is separated from the megass produced during the grinding of the sugar-cane in the manufacture of sugar, with vacuum pan molasses. The mixture results in a dry, brown-coloured, coarse powder possessing a very fragrant and attractive odour. Its specal characteristic is the relatively high digestibility of the fibre present in the food. Representative samples have the following composition :—

Moisture	17.3
Fat	.6
Albuminoids	1.5
Sucrose	36.1
Glucose	20.2
Other soluble Carbohydrates	7.3
Digestible fibre	7.6
Woody fibre	2.9
Mineral matter (ash)	6.3
	100.0

The high proportion (72 per cent.) of readily digestible constituents in molascuit is clearly shown in the above. For use as a cattle food it should be fed with an addition of another cattle food, such as cottonseed cake, containing relatively high proportions of albuminoids and oil.

RICE.

This industry is one pursued by small farmers and its development in the colony has been mainly due to the East Indian settlers. The black people in the colony also enter

with some enthusiasm into this industry. The proprietors of sugar estates give every facility in their power to their employees to carry on rice-growing.

The returns made to the Board of Agrculture show the great extension which has taken place in this industry of recent years. In 1898 the acreage returned by cultivators as being under rice was about 6,000 acres: for 1914* it was returned as about 45,000 acres. The increase in the crop of rice between 1809 and 1915 represents about 32,000 tons of cleaned rice per annum, the value of whch probably is about £450,000.

The enormous area in British Guiana pre-eminently suitable for the cultivation of rice should enable this colony to become the granary for the West Indian Islands.

The rice generally grown in the colony is a long-grained variety known as Creole rice, and seems to be one which has originated there by unconscious selection. It is of excellent quality equal to any that has been imported into the colony. The choicest strain of the creole rice, is that known as the "Berbice." It has been proved that by experimental cultivation we can obtain varieties of equally good quality but of higher yielding powers.
With this object in view large numbers—over 250—of varieties of rice have been imported into the colony by the Board of Agriculture. Of these varieties three have consistently given better returns than the creole has done, and about 10 tons annually of specially selected seed paddy is being distributed free to numerous growers of the colony. Further selections and crosses are being made year by year and the selected varieties are tried in trial plots against the standard kinds. The results of these experiments are most encouraging. Some of the selected varieties raised during the past few years show, on small plots, marked increases in yields over the standard varieties and are now being tried experimentally over larger areas.

The methods of cultivation generally in vogue are Eastern ones. Nearly the whole of the work is done by hand labour. Primitive ploughs and harrows are employed in many districts and cattle are sometimes used for the trampling out of the grain, while winnowing is usually accomplished by hand. Improvements in the methods of cultivation are being

*As two crops are reaped each year in certain districts the actual area of rice reaped in 1914 was 51,260 acres.

made, and increased returns have resulted. Rice is being cultivated and reaped on a large scale by modern appliances in the Abary district and the venture is full of interest as promising on account of the low costs of production to be very successful.

There are several large rice mills in different parts of the colony whilst there are a very large number of small ones scattered throughout the rice districts. From trials made, it has been ascertained that locally grown paddy gives about 60-65 per cent. of its weight of clean rice. Two kinds of rice are made; a brown rice in which the paddy is steamed before it is passed through the mills, and a white rice. Brown rice is more nutritious than the white rice. No polishing of rice is carried out. Ricemeal is made as a by-product and in 1914 240 tons were exported.

The following table gives the average yield of paddy (unhusked rice,) per acre in the colony from 1898 to 1914:—

Period.	*Average yield of padi per acre.*
1898-1902	20.7 cwt.
1903-1907	23.3 „
1908-1911	23.3 „
1911-1914	21.8 „
Mean	22.2

COCONUTS.

Coconuts thrive well on the coastal lands of the colony, especially where the land is more or less of a sandy nature, and expansion of this cultivation is steadily taking place.

The coconut palms growing in the colony are scattered, being owned chiefly by small growers, but there are a few fair-sized coconut estates, whilst extension over large areas is taking place on some sugar plantations. Reefs of light sandy loam exist on the Corentyne Coast, along the East Coast of Demerara, and in Essequibo, where coconuts flourish, and even on the heavier coastal lands they grow satisfactorily and bear very heavily. They do not grow so well nor yield satisfactorily on the pegassy-clay lands and on river lands away from the coastal region.

The area planted with coconut palms has been slowly increasing for some years, but during recent years there has been much greater activity in this direction and the continued extension of the industry may be expected. The following acreage

returns of the Board of Agriculture show the advance that is being made:—

1904-1905	..	..	..	..	5,140	acres
1905-1906	..	..	..	..	6,560	"
1906-1907	..	..	..	..	6,700	"
1907-1908	..	..	..	..	6,828	"
1908-1909	..	..	..	..	8,315	"
1909-1910	..	..	..	..	9,466	"
1910-1911	..	..	..	..	9,761	"
1911-1912	..	..	..	..	12,236	"
1912-1913	..	..	..	..	13,698	"
1913-1914	..	..	..	..	14,177	"
1914-1915	..	..	..	..	15,260	"

A very large proportion of the acreage under *coconuts* in the colony is still young and has not come into bearing.

The exports of coconuts are at present very small in relation to the number of acres in bearing, as the major portion of the nuts yielded by these areas are utilized in the colony for the preparation of coconut oil and of cattle food. There is a very large consumption of coconut oil especially among the East Indian section of the community and the locally prepared product has gradually replaced the imported coconut and other kinds of oil. During late years, however, the exports of coconuts have been increasing. This is due to the enhanced value of coconuts in the world's markets, which has rendered the exportation of nuts somewhat more profitable than the preparation of oil for local consumption.

The following table shows the annual average exports during quinquennial periods since 1892 :—

Period.					*Average Annual Export.*	
1892-1896	..	..	..	..	80,374	Nuts
1897-1901	..	..	..	..	21,892	"
1902-1906	..	..	..	..	187,305	"
1907-1911	..	..	..	..	526,901	"
1912-1914	(3 years only)	..	..		1,427,644	"

Coconuts are chiefly exported to the United States. A small quantity of copra is made in the colony, the export during 1914 being 1,690 cwts. The copra is the ordinary grade used for the extraction of oil and is mainly sun-dried, although attempts are being made at artificial drying.

The majority of the coconuts produced are used for the manufacture of oil for local consumption. For obtaining the oil, open coppers for boiling the grated coconuts are generally

used and the returns are not as high as they should be. There are a few oil factories in the colony.

COFFEE.

In the earlier part of the last century, British Guiana, and especially the county of Berbice, was celebrated for the high quality of the coffee it produced. Unfortunately, about the time of the cessation of slavery, circumstances beyond the control of the planters necessitated the gradual abandonment of the cultivation.

At the present time about 3,800 acres are occupied in coffee-cultivation, a large proportion of the product being consumed locally. Two kinds of coffee are cultivated in the colony, the Arabian or so-called creole kind, and the Liberian variety. Both sorts grow with exceptional vigour, and the former is singularly free from disease.

Large areas of low-lying land in British Guiana are ideally suited to the growth of Arabian coffee. The meteorological conditions of these parts of the colony are very similar to those of the higher parts of many of the West Indian Islands, and when this is borne in mind the excellent way in which coffee grows on them ceases to be surprising.

It is greatly to be regretted that local conditions, especially scarcity of available labour, tend to restrict the extension of the area under cultivation and that the usually low price of coffee does not offer much inducement for small capitalists to take up its cultivation.

The Liberian variety grows very well indeed in many parts of the colony, and wherever it flourishes it is very prolific: in fact, at times the difficulty is to restrain its bearing propensities sufficiently to prevent the tree permanently injuring itself. It is, however, on the wind-swept parts of the coastlands more adversely affected by unfavourable meteorological conditions than is the Arabian kind. But this is not the case at some distance back from the coast-line and on the lands along the lower reaches of the rivers.

The annual exports of coffee during recent years may be seen from the following statement :—

1907	.. 2 cwts.	..	1911	1.225 cwts.
1908	190 ,,	..	1912*	727 ,,
1909	.. 1,122 ,,	..	1913*	727 ,,
1910	.. 978 ,,	..	1914	2,132 ,,

*Crops affected by the prolonged drought of 1911 and 1912.

CACAO.

Cacao-planting is an industry of some promise in parts of the colony, but unfortunately it requires for its successful installation command of more capital than small farmers usually possess. Cacao requires for its satisfactory growth land well-drained to the depth of from three to five feet, and on land of this sort it does very well indeed. There are great areas of land a few miles up the lower reaches of the rivers where good drainage can be easily ensured and upon them cacao flourishes. It is to be regretted that persons with command of sufficient capital and with knowledge of the cultivation of cacao have not taken up its growth in these parts of the colony to a greater extent than has been done.

Some of the cacao estates are of fair age, but there are also considerable areas under young trees that have not yet come into bearing. The Government have an experimental area of cacao at Onderneeming, Essequibo, where from selected trees of high yield and good quality seeds are obtained for propagating purposes and increasing numbers of promising cacao seedlings are being supplied at low cost. Systematic experiments with cacao were commenced at Onderneeming in 1900. They have proved of value to the cacao cultivators in the colony by indicating that largely increased yields are obtainable by the reduction of the shade trees to the minimum necessary for protection of the cacao trees against wind; that large increases in yield result from heavily mulching the trees; and that the most profitable applications of artificial manures are of mixtures of sulphate of potash and superphosphate of lime, to which additions of nitrogenous manures are seldom remunerative; whilst nitrogenous manures, *per se*, tend to reduce the bearing powers of the trees.

The acreage under cacao cultivation during recent years is as shown below:—

1907-08	.. ..	1,832 acres
1908-09	.. ..	2,181 "
1909-10	.. ..	2,223 "
1910-11	.. ..	2,016 "
1911-12	.. ..	2,127 "
1912-13	.. ..	1,983 "
1913-14	.. ..	1,863 "
1914-15	.. ..	2,316 "

The decreases in the area returned as cultivated in cacao in the years 1912 and 1913 were attributed to the drought of 1911 and 1912 and to the abandonment of cacao in some cases for rubber cultivation. Practically only the Forastero variety is grown in British Guiana, other sorts being cultivated only to a very small extent.

At present therefore only about 2,000 acres are planted in cacao; their yield is mostly used for the local demands of the colony, and thus the export is small, not more, as a rule, than from 750 to 900 cwts. per annum. That exported brings a good price owing perhaps to the great care which is exercised in fermenting and curing the beans.

On some plantations kola-nuts are grown among the cacao producing a small yearly export of about 40 cwt. Among subsidiary products which do well wherever cacao and kola flourish, nutmegs occupy a prominent place.

RUBBER.

There are in British Guiana five indigenous species of Sapium, two of which yield rubber of marketable quality. The cultivation of neither of these species has, however, been successful owing to the low yields obtained from the trees.

All the sapium rubber exported in previous years from the colony as "Orinoco scrap" was derived from the wild forest trees.

Since 1907 some interest has been shown in the cultivation of Para rubber, there being now about 4,050 acres under cultivation in the colony. The increase in area will be seen in the following table:—

Year.	*Area.*	*Increase.*
1907	410 acres.	
1908	550 ,,	140 acres.
1909	1,000 ,,	450 ,,
1910	1,740 ,,	740 ,,
1911	2,260 ,,	520 ,,
1912	3,140 ,,	880 ,,
1913	4,000 ,,	860 ,,
1914	4,040 ,,	40 ,,

Companies formed for the cultivation of Para rubber hold the greater part of the land at present under cultivation, some 10,780 acres of Crown lands having been leased for this express

purpose. The trees are young and tapping on an extensive scale has not commenced. It is, however, anticipated that within a year tapping on an appreciable scale will be carried out by at least two of the companies at present engaged in the cultivation of Para rubber.

On suitable land the growth of the tree is not less rapid than it is in the East, while recent trials at the stations of the Department of Agriculture and on some private properties indicate that a yield of dry rubber per tree as good as that obtained on the best Eastern plantations is to be anticipated. The cost of collection of the rubber from a block of 400 trees at one station indicates that a reasonable profit can be expected with the market value of the product at 2/- per lb. The good health of the labour force, the low cost of supervision on estates and the proximity of the colony to the United States of America are factors which should encourage the extension of this industry in the colony.

LIMES.

Limes grow well on the lighter soils of the colony if they are protected from the full force of the wind. On the light, almost sandy soil of the Essequebo Coast they grow excellently, as also on the laterite soils of the Essequibo river. In the interior of the colony lime trees flourish around the various settlements, where they bear large crops of excellent fruit.

There are very large areas of loose, friable land that are well adapted to the cultivation of limes, whilst there is an enormous extent of ferruginous lateritic soils in many parts of the interior of the colony on which this crop can be successfully grown.

British Guiana should become one of the most important producers of limes and lime products in the world. The lime trees when well tended are generally free from diseases and insect pests, and the cultivations show signs of satisfactory progress.

The limes produced are juicy fruit, and their acid content is satisfactory. There is no difficulty in obtaining fruit for seed purposes and seed selection is now being paid attention to. Seedlings are readily raised, and after planting out need little attention if cultural and weeding operations are carefully carried out.

There are in the colony at present about 1·000 acres under limes: this area belongs mainly to two companies.

COTTON AND OTHER FIBRES.

The climate of the coastlands of British Guiana and the heavy nature of their available soils are not favourable for the successful growth of Sea Island or even of Egyptian cotton with commercial success. There are, however, several varieties of cotton in the colony which have been growing there for generations and which may now be regarded as practically indigenous. In the earlier years of the last century cotton obtained from these varieties formed a very important export from the colony. The cottons are perennial tree cottons and grow with great vigour, being apparently able to withstand the erratic meteorological conditions which sometimes prevail on the coastlands and which are detrimental to the yields of all varieties hitherto introduced. The lint is short-stapled and is of about the same quality or somewhat better than rough Peruvian, worth 6d. to 9d. per lb. The price is not sufficient to induce the cultivation of the cotton on an extensive scale. It is probable, however, that an impetus would be given to the cultivation if agencies for the purchase of the cotton in small quantities were established in the country districts.

Experiments in hybridisation have been in progress since 1908 by the Department of Agriculture having in view the production of a heavily bearing perennial variety yielding lint of the Sea Island type and there are indications that the objects of these experiments are being attained.

Among other fibres which offer promise for successful cultivation is the Ginger Lily, *Hedychium coronarium*. This is met with growing untended along the banks of some of the rivers on land containing fair quantities of organic matters, and a growth is there attained quite equal to that reported from Brazil. On the front lands of the colony on the heavy soil the plant does not make such good growth. Its experimental cultivation has been commenced by the Board of Agriculture both at the Botanic Gardens (coast) and at one of the Agricultural stations situated on the bank of the Aruka river, (North Western District). In the former experimental cultivation the green weight of the stems and leaves obtained from a first crop six months after planting was equivalent to 22 tons of the raw material per acre, while a ratoon crop equivalent to 27 tons per acre was obtained six months later. A heavy third crop is now on the land. The stems and leaves as cut gave one-eighth of their weight in dry material suitable for baling for shipment. The results of the latter experiment,

which is being carried out on a larger scale, are not yet available.

CATTLE RAISING.

There are very large areas on the coast lands of the colony which are well adapted for the pastoral pursuits especially for cattle-raising. At present there are about 90,000 head of cattle in the colony. About 600 head and a small number of hides—4,500—are exported annually.

Reference has been made to the very extensive savannahs of the far interior of the colony; upon these, great development may take place in cattle-ranching for which they are, reported by all who have visited them as specially well-adapted.

On the savannahs are scattered areas of well-watered fertile land on which the rancher can raise all kinds of tropical field and garden produce that he may require.

FUTURE EXTENSION OF AGRICULTURAL INDUSTRIES.

The sugar industry is by far the most important industry of the colony, and sugar with its by-products rum, molasses and molascuit contribute almost 75 per cent. of the total value of the exports. About 33 per cent. of the wage-earning portion of the population are directly connected with the sugar industry, while if those indirectly connected are included the proportion is in excess of 50 per cent. of the population.

44.7 per cent. of the empoldered area of the colony is under sugar cultivation. About 85% of this is reaped each year. This indicates that in round figures 38% of the empoldered land contributes to the yearly production of sugar. The average production of sugar over the colony during normal years is about 1.8 tons of sugar per acre. On well administered, suitably equipped and satisfactorily financed plantations the average yield in fair years may be taken as 2.10 to 2.20 tons of sugar per acre per annum.

A conservative estimate of the area of land well suited for sugar cultivation in the districts from the mouth of the Pomeroon in the north-west to the west bank of the Corentyne river in the east is 531,000 acres exclusive of the area already empoldered on sugar estates. Sixty-four thousand acres of this may be already beneficially occupied by products other than sugar leaving nearly 470,000 acres available for the extension of sugar cultivation. At the present proportion of land yearly cropped with sugar to the total empoldered area this would

give in round figures 178,000 acres to be reaped each year yielding a mean crop of 320,000 tons of sugar.

Given sufficient capital, labour, progressiveness and enterprise, the colony's sugar crop on its eastern area could be increased to 570,000 tons of sugar per annum which by fully applying modern scientific methods in cultivation and manufacture might be raised to 700,000 tons. Inclusive of the vast north-western section, on the coastlands and along the lower reaches of the rivers of British Guiana the total area of easily accessible land presumably well-suited for sugar cane cultivation and at present not otherwise beneficially occupied amounts in round figures to 1,620,000 acres. This area if fully planted and reaped under modern conditions of cultivation and manufacture could yield from 2¼ to 2½ millions of tons of sugar per annum.

PARA RUBBER.

Very large areas are available in the colony for rubber cultivation. The growth obtained by rubber trees has demonstrated that there are large tracts of land adjacent to the Demerara, Essequibo, Pomeroon and Berbice rivers and in the North-Western District which are pre-eminently suited for the cultivaton of Para rubber. It has been proved that the cost of collecting the product is reasonable. These facts indicate that extension of this industry in the colony should meet with much success.

LIMES.

There are wide areas of land available and very suitable for the cultivation of citrus fruits. The growth attained by trees planted on the light lands of the lower reaches of the Essequibo river fully justifies an extensive cultivation of lime trees in the colony.

COCONUTS.

This product is suitable for cultivation over large areas in the low lands of the colony. Local varieties of coconuts yield very heavy crops of medium sized nuts on relatively heavy clay soils on the coastlands, whilst on lighter lands similar varieties produce much larger sized nuts. There can be no doubt that the colony is emphatically a coconut land and that there are in it practically unlimited areas of land very suitable and readily available for coconut cultivation.

RICE.

Great extension of the lands under cultivation with rice may be expected in the near future. There are hundreds of

thousands of acres of land exceptionally well suited for its growth awaiting development.

CACAO, COFFEE, KOLA, FRUITS, ETC.

There are plenty of openings for the development of plantings of these products, the best of which perhaps are the lands bordering both banks of the Berbice river along its course from about 30 to 150 miles from its mouth.

FOREST RESOURCES.

These are practically illimitable; their utilization, however, is checked by difficulties of transportation in the interior of British Guiana.

BALATA.

The trees from which balata is obtained are found growing all over the colony particularly on the lower but not swampy lands along the banks of the smaller rivers and creeks. They are perhaps most abundant in the county of Berbice, where the balata collecting industry has been established for the past fifty years.

The collection of balata is carried out under licences issued by Government. For the purpose of the administration of balata collection the colony is divided into sections of 50 or 250 square miles in area, the former in the more readily accessible and the latter in the less readily accessible parts of the colony. A separate licence is issued for each section and confers the right to collect wild rubber as well as balata. The terms are for not more than 15 years, an application fee of £1 13s. 4d. and an annual rental of £4 3s. 4d. for each licence, and a royalty of 1d. per lb. on all balata and wild rubber collected. The licences are issued for collecting only and may be cancelled if the land is required for agricultural or mining purposes. The collection is carried out by Negroes and Aboriginal Indians who are registered as bleeders. No tree is allowed to be bled which does not measure 36 inches in girth at 4 feet from the base. Trees may be bled on one-half of the circumference only at any one time. No tree is allowed to be re-bled until 5 years have elapsed from the previous bleeding. The cuts employed for extracting the milk must be not more than 1½ inches wide and not closer together than 10 inches.

The collectors proceed to the grants from January to April and the work generally commences towards the end of May and extends to the beginning of October. The collectors are paid by the weight of balata obtained.

Bleeding is done by means of a cutlass; the incisions are 10 inches apart and are arranged in a feather-stitch pattern. Bleeding is commenced at the base of the tree and extends to the main fork; the branches of trees are seldom bled. The milk is collected in a calabash (made from the fruit of *Crescentia cujete*), placed at the bottom of the tree and held fast by inserting its lip between the bark and wood of the tree. The first bleeding is done while the collector is standing on the ground;; the parts of the trunk situated higher up are bled by the aid of a ladder roughly constructed in the forest, while the highest parts are frequently reached by the aid of a rope for climbing.

The latex is transferred from the calabashes to kerosene tins and taken to the camp where it is poured into a shallow tray (dabree) and allowed to evaporate. This tray is constructed generally of pieces split from the stem of a palm. The latex coagulates by evaporation and the gum is removed in successive sheets from the top to the bottom.

The yield varies up to certain limits according to the age and size of the tree. Speaking generally, five pounds of dry gum per tree is considered a good yield.

Recent investigations have shown that the yields obtained by bleeding standing trees with cuts arranged in the feather-stitch pattern are not less than those obtained by first felling the trees and then extracting as much latex as possible by completely ringing the bark: and this fact has prevented the ruthless destruction of the tree which is valuable for its timber as well as for its production of the gum.

The following table shows the export of balata in five year periods since 1893:—

Period.	*Total.*
1893-1897	1,133,123 lbs.
1898-1902	2,009,785 „
1903-1907	2,488,951 „
1908-1912	5,376,059 „

The exports go chiefly to the United Kingdom, the remainder going to the United States of America and to Holland.

The export of balata from the colony for the year 1913, was 1,323,609 lbs. of the value of £160,000. Owing to the war closing some of the more important European markets, the export for 1914 fell to 1,022,750 lbs.

As the balata tree occurs in large quantity in the forests of the colony, providing the gum continues to realise its present market value, there is the prospect of the balata industry continuing to flourish for many years to come.

RUBBER.

From time to time small quantities of wild rubber are collected in the forests from the indigenous rubber yielding species of *Sapium*. The rubber is of good quality. It is usually classed on the market as "Orinoco Scrap," and if clean fetches fair prices. Small quantities of soft inferior rubber also are yielded by indigenous varieties of *Hevea*, but there is very little chance of any development in the collection of rubber from indigenous trees taking place.

TIMBER.

The forests of British Guiana cover some 78,000 square miles of country or about six-sevenths of the whole area of the colony. The forests extend throughout the whole colony but are broken at intervals by areas of savannah land. At present the workable area is confined to 11,000 square miles in the more readily accessible parts extending from the sea coast to where the courses of the large rivers, beyond their tidal reaches are interrupted by cataracts, rapids and falls. Timbers having a higher specific gravity than water cannot be transported by water carriage over these obstacles. Therefore the utilisation of the practically illimitable forest resources of British Guiana is checked by great difficulties of transportation. There is little doubt that an enormous development of the timber industry would follow the institution of transport facilities by a railway to the interior of the colony.

The trees composing the forests of British Guiana are rarely of social habit. Many different kinds of trees exist in any one area and the forests are of the class termed "mixed." The forests vary in height. On the low coastlands and along the tidal reaches of the rivers the average height of the trees would be about 60-70 feet, but further inland they are more lofty and are on the average about 100 feet in height. As a rule the trees in the high forest rise with straight clean stems and are of small girth.

In parts of the forests it is usual for various kinds of trees to predominate and to form more or less broadly defined natural divisions of forest growth. These are known locally by the name of the prevailing kind of timber as the green-

heart, wallaba and crabwood forests. Frequently the predominance of different kinds of timber is confined to situations defined by the nature and condition of the soil, and thus the natural divisions of forest growth are accentuated by differing conditions of soil, and topographical features.

The following industries are carried on at present in connection with the forests of the colony:—

Woodcutting for (a) Timber and lumber.

(b) Wallaba shingles, paling staves, and posts.

(c) Charcoal.

(d) Fuel.

Labourers for transportation or general work are engaged in these industries under contract for periods up to three months at a daily wage. For felling trees and squaring timber trained wood-cutters are required and are paid at an agreed rate per cubic foot of the timber squared where felled. All hauling is done by gangs of men or by oxen, and the greater portion of the timber is floated down the rivers to convenient points for export.

The following are notes on the more important commercial timbers:—

Greenheart is commercially the best known of all the timbers of the colony. Large quantities have been regularly exported for many years. It is rated as a first class wood at Lloyds and it is chiefly used for submerged works such as wharves, piles, dock and lock gates.

The brown or yellow greenheart is hard, heavy, tough, strong and elastic and is said to have the property of resisting the Teredo. The black variety is much scarcer. It can be distinguished from the brown variety by its colour and greater hardness. Logs of greenheart can be obtained from 10 to 25 inches square, and up to 65 feet in length.

In habit the greenheart is partly gregarious. It favours hilly land with a sandy clay soil, and is usually found more abundantly on the slopes of the hills. The greenheart areas are estimated to contain an average of thirty-two greenheart trees to the acre and are almost entirely confined, to the central parts of the colony which are traversed by the Essequibo. Demerara and

Berbice Rivers and their tributaries. There is a large quantity of this wood in the interior regions waiting easier means of transport for exploitation.

Crabwood.—There are two varieties of West Indian Mahogany (*Carapa guianensis*), locally termed crabwood, the red and the white. The red is a red coloured wood, with a moderately coarse and open grain. It is largely used in the colony for building purposes and is the most popular furniture wood. It resembles Mahogany in appearance when polished and has proved itself to be a good substitute for that wood. The white is similar in structure to the red variety but paler in colour and of less specific gravity. Logs of this wood can be obtained from 40 to 60 feet long, and from 10 to 16 inches square.

The wood is found growing scattered throughout the forests of the river valleys of the colony, particularly on low lying flat lands subject to inundation either by high tides or heavy rains. It also occurs in lesser quantities in the more elevated country.

Wallaba—There are several varieties of this wood; those principally used are "Soft Wallaba" (*Eperua falcata*) and "Ituri Wallaba" (*Eperua Jenmani*). The heart-wood of these varieties is in great demand for posts and for making shingles, palings, vat staves, etc. Wallaba is a heavy, hard wood, with a very coarse but more or less even grain. It splits readily, is very resinous, and has an unpleasant smell which, however, disappears after a sufficiently long exposure. It is probably the most abundant of the colony's timbers.

On the slightly elevated and hilly lands of loose white sand situated in the central and eastern parts of the colony the Wallabas constitute about 40 per cent. of the forest trees. In the forests of the swamp lands the two kinds abovementioned together with "Bimiti Wallaba," which is only used for fuel, are found on places where the soil is more or less of a sandy nature.

OTHER WOODS.

In addition to the above mentioned woods there are many other valuable woods, of which at times some are exported in small quantity.

Hard woods.—The following hard woods may be mentioned: —Mora (*Dimorphandra Mora*) rated first-class at Lloyds, and used for railway sleepers. It grows near to the banks of the rivers and creeks, is of large size and is useful for many

purposes. Bullet Tree (*Mimusops globosa*), is now cut only by permission for special purposes, it being the source of balata. The wood is dark red, close-grained, heavy and durable. Surandanni (*Hieronima alchorncoides*) grows in low situations and is fairly plentiful. The wood is of a deep red colour. Purple-heart (*Copaifera publiflora*) is one of the tallest trees of the forests. The wood is a dark purple colour and is hard, close-grained and durable. Locust or Simiri (*Hymenoea Courbaril*) grows in sandy soils. The wood is hard, heavy and close-grained, and takes a fine polish.

Other hard woods of local commercial value are Hackia (*Siderodendron triflorum*). Towaronero (*Humiria balsamifera*), Kakaralli (*Lecythis corrugata*), Tonkin bean or Kumara (*Dipteryx odorata*), Hiawaballi (*Omphalobium Lambertii*), Kabukalli (*Goupia glabra,*) and Phokadie (not identified.)

Soft-woods—Silverballi or Siruaballi (*Nectandra spp*), of which there are several varieties, the Yellow, Brown, Keritee, Yekuru and Mainap, are all handsomely grained woods with an aromatic scent. They are durable woods and are used principally for planking boats, and for making knaves of wheels. Determa (*Nectandra sp.*) is well adapted for making corials and canoes and for masts and spars of vessels. It is a light, strong wood, resembling cedar in colour. Soft woods of local commercial value are Hooobooballi (*Mimosa guianensis*) Arrisouroo (*Pterocarpus guianensis*), White Cedar (*Tabebuia longipes*), and Red Cedar (*Protium altissimum.*)

Very Soft Woods.—Simarupa (*Simaruba officinalis*), grows throughout the colony specially on sandy soils. The wood is of light colour and is close-grained. It is useful for inside house work. Dalli (*Myristica surinamensis*), and Photee (*Jacaranda Copaia*) occur in fair quantities and are used for lumber, making match boxes, etc.

Charcoal Burning.—This industry is principally carried on where the lands are of a sandy nature on the Demerara and Berbice Rivers. The wood is converted into charcoal by burning it in covered pits dug in the sand, in which the wood is packed with the coarser material in the middle. All kinds of wood, and all parts of the trees are used. The charcoal is largely exported to the Southern West Indian islands.

FIRE WOOD.

On the sea coasts Courida (*Avicennia nitida*), is much used as a firewood. On the river lands all kinds of woods are cut for

fuel, but Wallaba is mostly favoured, as it splits readily and burns well. Practically all the firewood exported is obtained from the lower Demerara River, whence it can be transported cheaply for shipping to Barbados and other West Indian islands.

EXPORTS OF TIMBER PRODUCTS.

The Colony annually exports about 250,000 cubic feet of timber, 80,000 bags of charcoal, 8,500 tons of firewood, 250,000 feet of lumber and 2,500,000 wallaba shingles. These exports have a total average value of £37,000 a year.

GUMS, OILS, RESINS, ETC.

Small quantities of gums are collected and exported. Gum Animi, a product of the locust tree (*Hymenoea Courbaril*) is exported in small quantities. At one time there was a good demand for this product but not much has been exported of late. The fossil gum resembles amber in appearance and is often found in blocks of considerable size.

Hiawa gum or Resin of Conima used for incense is obtained from *Protium heptaphyllum,* a tree common in all localities of the colony, and can be had in considerable quantities.

Tonkin beans are collected and exported. They are the yield of the Kumora or Tonkin bean tree, a large tree growing plentifully in localities above the rapids and in the upper islands of the Essequibo River and its tributaries.

Souari nuts (or Butter nuts), the product of *Caryocar tomentosum* are also collected. The Souari nut tree is one of the giants of the forest and thrives best on hilly lands of a clayey nature. Trees under cultivation at Onderneeming Experiment Station have fruited in six years from planting.

The seeds of the Carapa, or Crabwood, are collected and from them the well-known "Crab-oil" is obtained. The greater proportion of this oil offered for sale is manufactured by the Indians.

It is very evident from the foregoing that British Guiana is a land of vast potentialities only limited by lack of transport facilities, labour and capital. It is reasonable to expect that provision of quick and cheap means of transport such as would be supplied by railways traversing in various directions the interior of the colony would be quickly followed by an influx of labour and of capital by which the great resources of the colony would be rapidly developed.

The Cultivation of Limes: I.

By Professor J. B. Harrison, C.M.G., M.A., Director, and C. K. Bancroft, M.A., F.L.S., Assistant Director, Department of Science and Agriculture.

An article on lime cultivation was published in this Journal (Vol. IV. No. 1 of July, 1910), and was reprinted by special request in the following number in October of the same year. The cultivation of limes on a large scale in the colony was then a recent undertaking, the two large plantations Agatash, Essequibo, and Providence, Berbice, being in the making. It has been considered desirable to re-write the article, including data which have more recently been acquired, so that the information relative to the subject of lime cultivation might be brought up to date.

HISTORICAL.

The lime of British Guiana and the West Indies is confined to tropical and sub-tropical countries. It is not a native of the Western Tropics but was introduced to the West Indies from India, where it is said to be indigenous to the hot regions situated at the foot of the Himalayas. The date of introduction of the plant is not known, but mention is made of its occurrence in Jamaica at the end of the 17th century. The plant probably found its way to the British West Indian Islands from Martinique. Towards the middle of the 19th century the cultivation of the plant was commenced both in Dominica and in Montserrat. More particularly in the former island the lime industry has considerably increased in recent times, and has also been extended to St. Lucia, Trinidad, Antigua, Cariacou and British Guiana.

BOTANY OF THE PLANT.

The cultivated lime is *Citrus medica, var. acida,* of which there are two varieties, the 'common' or 'spiny' and the 'spineless.' The former is the original plant and is the one more extensively cultivated. The latter is of comparatively recent origin, its first record extending only back to 1891, when it was collected and sown by Mr. Green, Curator of the Botanic Station, Dominica.

The common lime is a tree of medium height, attaining 24 feet when fully grown. The leaves are oval with a serrated margin and possess a distinct petiole which is naked or slightly winged. The flowers are small, white, with a characteristic

perfume, and arise in small groups in the axils of the leaves on the young branches. The tree under suitable conditions flowers freely. The flowers are hermaphrodite; the calyx and corolla lobes number 5 to 7 and the stamens about 20. The fruit is globular and one to two inches in diameter, green when young and yellow at maturity, its wall containing numerous oil sacs and enclosing a pulp rich in acid juice.

The spineless lime is a chance variety arising by mutation, whose characters have been partly fixed by careful selection, about 75% of the seedlings obtained from seeds of spineless limes being without spines. The leaves differ in shape from those of the common lime and the fruits are small and possess a smooth, thin skin and comparatively few seeds. The fruits are very juicy and the juice is said to be purer and richer in acid than that of the common lime. The plant when young is said to be more erect in habit than the common variety.

Whether the spineless lime is in any way preferable to the common lime for planting is a matter of doubt. The plant possesses an advantage in having no spines, thus enabling weeding, cultivation, etc., to be carried out with less difficulty. Its fruits, however, are small and there is no reliable evidence that it is a heavier bearer than the common variety; and it is doubtful whether an alleged somewhat higher acid content of their juice compensates for the small size of the fruits.

Seedless varieties have been noticed in Trinidad, Dominica and Montserrat. These are, however, of little value to the planter owing to the difficulty and cost of propagating them. The cultivation of either the spineless or the seedless variety cannot be recommended for British Guiana.

CLIMATE AND SOIL.

The lime grows best in tropical and sub-tropical regions where the maximum and minimum temperatures oscillate between 90° and 60°F. In Dominica it thrives from sea level up to an altitude of about 1,300 feet. Flat or slightly undulating lands are, however, considered to be the most suitable for its cultivation. A rainfall of from 80 to 115 inches per annum appears to be most suitable for lime cultivation. A fairly even distribution of rainfall is required, without excessive precipitation during the flowering season. Given the latter condition, the lime is successfully cultivated in districts having a rainfall as high as 150 inches per annum. Lands characterised by rich light soil and protected from the wind yield the most satisfactory growth of limes. The plant grows well on the light, sandy soils of the Essequibo Coast and thrives on the red lateritic soils in

many parts of the interior of the colony. On the heavier clay soils near the coastlands of the colony the plant is difficult to establish and the cultivation requires more careful attention and is relatively costly. Speaking generally, the lighter soils of the colony are very suitable to the growth of the plant. The lands most eminently suited to lime cultivation in the colony are rich, light, undulating areas well sheltered from the wind. Such soils are of fairly constant occurrence on the banks of the Berbice river.

PREPARATION OF THE LAND.

The land selected for a lime plantation may either be virgin forest land or secondary forest, or land previously under cultivation in another crop. Land cleared from secondary forest is almost invariably characterised by a thick, almost intractable growth of undesirable weeds, so that the expenses of keeping the cultivation clear are apt to be far in excess of those on land cleared from primeval forest.

The lime does not grow satisfactorily when exposed to strong wind; the trees become stunted and large numbers of flowers are blown off when the trees are in flower. In clearing forest land the tops of hills should not be bared of bush, but should be left to form protective belts. Lines of wind belts, about 2 chains wide, should also be allowed to remain on the plantation. On flat lands exposed to wind, belts of quick-growing trees must be established early. For this purpose any of the following trees may be employed:—Oronoque (*Erythrina glauca*), Pyrowo wykee (*Inga ingoides*), Malacca apple (*Eugenia malaccensis*), Pimento (*Pimenta officinalis*). The first-named is in more common use in the colony than any other tree for shade purposes. It is necessary to plant the trees close together and to keep them trimmed so that they form a dense growth.

The plantation should be laid out in blocks, preferably of 50 acres, either square or rectangular, so as to render the control of cultural operations more easy. A central position should be chosen for the buildings, factory, etc. On a large estate of 500 acres or more it would be more convenient to place the ranges on different parts of the estate so as to enable the labourers to commence work early. Roads should be carefully outlined at the beginning, if they are required, as the produce is bulky and requires to be handled cheaply, or if transport is to be done by water, the positions of navigation trenches should be carefully chosen.

Drainage requires careful attention and it should be well established before planting is commenced. Light land may possess in great part natural drainage. Hilly slopes will require

a system of contour drains to prevent loss of the surface soil through the wash. The drainage should be both early established and effective, as on it the success of the cultivation will in great part depend. The system of spiral contour drains suggested in 1895 by the senior of us for plantations in Grenada, should be employed. In this the contour drains run around the hill in a gradual ascending spiral, short communicating drains between one drain and the next one above it being placed at gentle angles here and there as required. In draining a hill side the same plan, should be followed, with the exception that the drains should connect with each other at the ends. Paths are constructed when the drains are being dug by throwing the earth from the drains on the outer side.

SEED BEDS.

The raising of seedlings should be given early consideration. These may be established in nursery beds. Planting of seed at stake has been attended in some places with satisfactory results, but it is recognised that the transplanting of carefully selected seedlings is the safer method to adopt.

The seed-beds will require careful preparation. They should be made on flat land in light rich soil or should be carefully prepared with sand, leaf-mould and well decayed pen manure. If the soil is very heavy it may be advisable to germinate the seeds in boxes in soil prepared from two parts earth, one part of sand and one of leaf-mould or manure.

Seeds should be selected for planting purposes from healthy, good-bearing trees. They should be well washed on a sieve so as to get rid of all of the mucilage before sowing in order to prevent rats and other animals from destroying them. They should then be dried in the shade.

The seeds should be sown in rows about 8 inches apart in drills 1 inch deep, the seed being sown thinly in the open drill and then covered over. From three to five feet is a good width for a seed bed. Germination takes place in from 15 to 20 days. When the plants are 4 to 6 inches high they are ready to be transplanted into nursery beds. The plants are carefully lifted, their rootlets trimmed and the stems are topped. They are then removed to the nursery beds where they are planted. The seedlings can generally be transplanted when they are six months old. A careful selection of seedlings should be made with a vigorous rejection of ill-grown ones.

PLANTING.

The land should be prepared and well-lined. On good flat land the rows should be not closer than 20 feet. What the best

planting distance is, is still a matter of doubt. In the West Indian Islands 15′ x 15′ is said to be the usual planting distance on good flat land, while on hilly slopes 12′ x 12′ or 14′ x 12′ is a common distance. This, however, is too close for the vigorous growth of the trees in this colony; there is no doubt that 20′ x 20′ should be a minimum planting distance on good land ; while on steep slopes the trees may be planted 16′ x 16′ apart.

Holes 18 inches square by 18 inches deep should be opened to receive the plants. They should be allowed to remain open for some time, and then filled in with thoroughly broken up soil. When the land is ready for planting the plants should be lifted from the nursery with forks. In Dominica they are transplanted to the field when they are 16 to 18 inches high; but the experience in this colony is that the plants should be allowed to grow taller, 24 to 30 inches. The roots should be lightly trimmed so as to remove all injured ones. Care should be taken to avoid an undue amount of exposure of the plants to the sun before they are transplanted and the planting should be carried out at the same depth at which the plants were growing in the nursery.

The best planting month in this colony is April or May, but planting may be carried out in other parts of the year except in August to November when the weather is invariably dry. The seeds must, therefore, be sown at a time which will allow of the seedlings being planted in good season. The use of stumps, two years old or more, for planting purposes has been found successful. They should, however, not be too large (more than ½ inch in diameter) as in this case they tend to give rise to a large number of branches and thus to make trees of undesirable shape. In any case stumps require more care in trimming during the early stages of their growth than do selected seedlings from the seed beds. Well shaped trees are an important asset to the profitable cultivation of limes.

CULTIVATION.

Lime trees may give a few fruits in the third and sometimes even in the second year, but it is generally recognised that full crops cannot be expected until the trees are eight or nine years old. It is, therefore, possible to raise crops of cassava, pigeon peas or provisions between the lime trees. If this is done, care should be taken to avoid planting these crops too close to the lime plants, or so thickly as to injure them. It is a common practice in this colony with cultivations of products similar to limes, and one which has much to recommend it, to give out portions of a cultivation free of rent to small

farmers who are allowed to grow provision crops on the land providing that they keep the cultivation clean of weeds. This is a plan which should be encouraged in establishing a lime cultivation; but it is necessary to enforce a rule that the provisions are not planted closer to a lime plant than six feet. It is also advisable to allow not more than two crops of provisions to be taken off the land. The lime tree possesses an extensive surface root system and while for the first year or two the plants will benefit by being kept clean of weeds and also by the tillage of the land in the cultivation of the catch-crops, it is certain that their growth will be retarded by the presence of the catch-crops after the second or third year. The cultivation of root crops or other crops which require to be dug up should *not* be practised *on hilly slopes*, but should be confined to flat land, as digging loosens the soil and a considerable amount of wastage by rain-wash takes place. It is well recognized that on hilly lands an attempt should be made to encourage a sod. Grass and low-growing, creeping weeds should be allowed to grow, and where there is any difficulty in this direction cover crops of low-growing plants should be sown. When the "sod" has become established a gradually increasing area should be kept clean around each tree as it develops.

Native low-growing weeds and creeping plants which will repay encouragement are *Desmodium, Abysicarpus vaginalis, Ipomoea sp, Phaseolus semierectus*, Withers' *Phaseolus*.

In new clearings made from original forest grass is slow to establish itself, while bush grows rapidly. The latter should be kept down or otherwise it will kill out the grass and low-growing weeds, and when cleaning is carried out the soil will then become exposed to the full rays of the sun and to the wash of the rain.

The encouragement of creeping plants by cutlassing the bush down to the level of the creepers, broadcasting the seed of the creepers on areas where they are scarce, coupled with the cleaning of a circle of land around each tree, has given good results on one plantation in the interior of the colony opened up from virgin forest land, and can be recommended for lime cultivation under similar conditions.

Mulching should be continuously carried on, and wherever any bush or weeds are cut down they should be placed around the trees in an encircling ring. The distance of the ring from the base of the stem should be roughly the same as the distance of the outermost btanches from the trunk of the tree. *Mulch should never be piled up around the base of the tree;* this, as

also the piling up of earth around the collar of the trees does much to encourage the development of what is known as "collar-rot" or 'gummosis.' When a lime plantation is newly opened up, and for a period of some years afterwards, an abundance of material for mulching can be obtained from the weeds growing in the cultivation itself. As this gets older, however, it may be necessary to cut material for mulching from lands adjacent to the cultivation. It is becoming generally recognised that the humus content of the soil should be kept up by the addition of constant supplies of organic matter, and mulching is a practice which is generally increasing in favour.

The question of periodic tillage is one which requires some consideration. Where limes are growing in heavy clay soil forking at intervals should do much towards encouraging their growth. This, however, is expensive and should have been avoided in the first instance by selecting more suitable land for the cultivation of the plant. Forking on heavy land costs $15 or more per acre. The question of tillage is one which should be determined largely by the cultivator himself, and will depend on the conditions under which the limes are growing. Providing the plants are growing under suitable soil conditions and have been given a fair chance in the early stage of growth, little or no cultivation is needed. The usual cutlassing four times per annum at the beginning—which may be reduced to twice per annum as the trees get older and the cover crops become established—should suffice for the growth of the plants on suitable land. This operation usually costs $3.00 per acre. If tillage is required, then a light forking occasionally at $7.00 per acre should be sufficient.

In some places, and more especially on the lateritic and sandy soils of the colony, it may become desirable to manure the trees with artificial fertilisers. Great caution is necessary with regard to this, as applications of active nitrogenous manures although apparently favouring the growth of the tree may for a time reduce its flowering and fruit-bearing functions. Our light soils are not unfrequently very deficient in potash and lime, and it is these constituents which may be the first to fail in lime cultivation. If from the appearance of the trees the desirability of artificial manuring is noticed, a mixture of sulphate of potash with either very finely ground slag phosphate or basic superphosphate should be tried. Probably an application of 2 cwt. of sulphate of potash intimately mixed with 1 cwt. of basic superphosphate and lightly forked into the soil near the margin of the cleared area around each tree will prove useful and remunerative. If applications of nitrogen are required, 80 lb. of nitrate of soda or 100 lb. of nitrate of lime per

acre should be scattered over the surface of the soil in a similar position to where the mixed manures are directed to be applied.

It has been for some time known that on heavy clay lands such as those near the coastland of the colony dressings of lime have a highly beneficial effect on the growth of limes and other citrus plants. Applications up to 11 lbs. of lime per tree may be made with advantage under these conditions. Fairly freshly slaked lime should be employed. On the lateritic soils, too, in the interior of the colony, lime would doubtless prove beneficial. To this type of soil lime which has been allowed to become thoroughly 'mild' would be preferable to freshly slaked lime.

PRUNING.

The pruning of lime trees requires some attention. There are some who hold that the trees can without danger be left to themselves; but there is little doubt that well-grown, shapely trees form a good asset to a cultivation. Long suckers and dead branches should always be removed, except when (in the case of the former) it is required to replace with them older branches which have died from some cause or other.

In this colony it has been constantly observed that lime trees tend in many cases to branch low down at an early stage. These low branches should be removed and a clear stem for a height of about 3 to 3½ feet preserved. The advantage in this is obvious, for it facilitates both weeding and the picking of the fruit.

Prunings should, where possible, be collected and burnt so as to avoid injury to the labourers from the spines. Coal tar should be placed on each cut surface in a thin layer after pruning.

(To be continued.)

Alcohol as Fuel in the Tropics.

Persistent agitation, during the past two years, in favour of alcohol as a source of power in the tropics, does not appear to have resulted so far in the achievement of anything definite. Several well-known authorities on sugar manufacture have advocated the utilization of molasses in this direction, and have shown that the proposition is a practical one ; other writers have called attention to the value of the by-products on banana, cacao and coconut estates ; while in sub-tropical countries the cultivation of corn and starch-producing crops has been mentioned as another source from which alcohol might be produced.

—"Agricultural News," Barbados, July 3, 1915.

Cotton Hybridisation at the Botanic Gardens.

By Prof. J. B. Harrison and C. K. Bancroft.

All of the numerous experiments made since 1902 with regard to the cultivation of Sea Island cotton demonstrated that, owing to the unsuitability of the heavy soil and of the meteorological conditions existent on the sea-board of the colony, the cultivation of the Sea Island cotton on or near the coastlands of the colony would meet with failure. The season 1907-8, the most favourable one during which the experiments were conducted, produced a yield only at the rate of 268 lbs. of seed cotton per acre. Other varieties have been under trial more or less continually since 1890, special trial having been given to certain Egyptian varieties. Sixteen varieties were under cultivation in 1904 and 1905. Some promising results were at first obtained by seed selection of Egyptian cottons. But it was evident as the result of the various trials that the different varieties would not yield lint in sufficient quantity to enable them to be grown at a profit. All of the varieties tried, except the Buck, were found to be very susceptible to the diseases prevalent among cotton plants, more especially to anthracnose and to cotton boll rot.

As the result of these trials, efforts were directed towards raising hybrids between the Sea Island and the native Buck cotton, the object being to combine the vigour and perennial habit of the latter with the quality of the lint of the former. The first successful cross-fertilisation of Stirling Sea Island and the Buck was attained in January, 1906. The seeds obtained from the crosses, however, failed to germinate. Another set of crosses was made in 1907; and 105 of the F_1 hybrids were planted early in the following year. Field selection of the plants was made and those possessing desirable characters coupled with a good quality of lint were retained as parents of the 2nd generation. The selection was continued in the 3rd and 4th generations, and of the F_4 generation 24 plants were retained. Of these lint was selected from ten Nos. 1-10, and forwarded to the Imperial Institute for report and valuation in March of this year, along with two F_1 hybrids—Nos. 11 and 12 raised fromNative Suwardi and a hybrid Sea Island x Buck. The report received from the Imperial Institute indicates that the desired object has been attained. The report is as follows:—

"The hybrid cottons Nos. 1-12 are mostly of shorter staple and somewhat coarser than the sample of Sea Island cotton (No. 13). They are however stronger than the latter, and the brokers stated

that on account of their strength most of these cottons would be readily saleable at the prices quoted. It will be noticed that several samples, viz., Nos. 1, 5, 6, 8 and 11, were valued at higher prices than the Sea Island cotton No. 13, but that in no case was the value equal to that of "best Barbados" Sea Island cotton.

"The Native Buck cotton was of good quality and was valued at 0.68d. per lb. above "middling" American.

"It should be noted that the small size of the samples rendered it difficult to ensure exact valuations, and the present estimates of their commercial value must only be regarded as approximate.

"It is satisfactory to observe that the aim of obtaining a Buck x Sea Island hybrid yielding a cotton of long staple has been achieved, and it would be interesting to learn how the yields and hardiness of the hybrids compare with those of the indigenous Buck variety."

The Brokers' valuation of the lint from the different hybrid cottons varied from 11d. to 14d. per lb. with the best Barbados Sea Island at 14½d. The detailed reports of the different samples submitted, along with their valuations are as follows:—

IMPERIAL INSTITUTE.

Results of the Examination of Cotton from British Guiana.

I.

Date.	30th June, 1915.
Reference.	Letter No. 520 4820 dated 18th March, 1915, from the Director of Science and Agriculture Department, Georgetown.
Imperial Institute No.	58275-1.
Variety of Cotton.	Hybrid No. 1: Stirling Sea Island x Native Buck.
Description.	Ginned and unginned cotton.
Lint:	Clean, soft, lustrous of cream colour, and slightly stained.
Seeds.	Large black seeds, without fuzz.
Strength.	Fairly good.
Length of fibres.	From 1.5 to 1.9 inch ; mostly from 1.7 to 1.8 inch.
Diameter of fibres.	From 0.0005 to 0.00095 inch ; average 0.00069 inch.
Microscopical characters.	Normal.
Commercial valuation.	14d. per lb., with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

II.

Imperial Institute No.	58275-6.
Variety of Cotton.	Hybrid No. 6: Stirling Sea Island x Native Buck.
Description.	Ginned and unginned cotton.
Lint:	Clean, soft, lustrous, of cream colour and free from stains.
Seeds:	Black, medium-sized seeds with a small tuft of brown fuzz at each end.
Strength.	Good.
Length of fibres.	From 1.5 to 2.0 inches; mostly from 1.7 to 1.9 inch.
Diameter of fibres.	From 0.0005 to 0.00075 inch; average 0.00060 inch.
Microscopical characters.	Normal. A small proportion of immature fibre was present.
Commercial valuation.	14d. per lb. with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

III.

Imperial Institute No.	58275-8.
Variety of Cotton.	Hybrid No. 8: Stirling Sea Island x Native Buck.
Description.	Ginned and unginned cotton.
Lint:	Clean, soft, lustrous, of cream colour and slightly stained.
Seeds:	Large black seeds, with a tuft of brownish fuzz at each end.
Strength.	Fair.
Length of fibres.	From 1.2 to 1.7 inch; mostly from 1.4 to 1.6 inch.
Diameter of fibres.	From 0.0005 to 0.0009 inch; average 0.00061 inch.
Microscopical characters.	Normal.
Commercial valuation.	14d. per lb. with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

IV.

Imperial Institute No.	58275-11.
Variety of Cotton.	Hybrid No. 11: Cross between Native Suwardi cotton and "Sea Island x Native Buck" hybrid.

Description.	Ginned and unginned cotton.
Lint:	Clean, fairly soft, lustrous cotton, of cream colour with a reddish tinge, and free from stain.
Seeds:	Large dark chocolate-coloured seeds, with a tuft of white fuzz at the blunt end.
Strength.	Good.
Length of fibres.	From 1.2 to 1.7 inch; mostly from 1.4 to 1.6 inch.
Diameter of fibres.	From 0.0005 to 0.00075 inch; average 0.00061 inch.
Microscopical characters.	Normal.
Commercial valuation.	14d. per lb., with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

V.

Imperial Institute No.	58275-5.
Variety of Cotton.	Hybrid No. 5: Stirling Sea Island x Native Buck.
Description.	Ginned and unginned cotton.
Lint:	Clean, soft, lustrous, of cream colour and free from stains.
Seeds:	Large dark chocolate-coloured seeds, with a small tuft of brownish fuzz at each end.
Strength.	Fairly good.
Length of fibres.	From 1.6 to 2.2 inches; mostly from 1.8 to 2.0 inches.
Diameter of fibres.	From 0.0004 to 0.00075 inch; average 0.00057 inch.
Microscopical characters.	Normal.
Commercial valuation.	13d. to 14d. per lb. with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

VI.

Imperial Institute No.	58275-4.
Variety of Cotton.	Hybrid No. 4: Stirling Sea Island x Native Buck.
Description.	Ginned and unginned cotton.
Lint:	Clean, soft, lustrous, of cream colour, and almost free from stains.

Seeds:	Large black seeds, with a small tuft of brownish-white fuzz at each end.
Strength.	Fairly good.
Length of fibres.	From 1.3 to 1.8 inch; mostly from 1.5 to 1·7 inch.
Diameter of fibres.	From 0.0005 to 0.0008 inch; average 0.00065 inch.
Microscopical characters.	Normal.
Commercial valuation.	12d. to 13d. per lb., with "best Barbados" at 14½d and "best St. Kitts" at 16d. to 17d. per lb.

VII.

Imperial Institute No.	58275-10.
Variety of Cotton.	Hybrid No. 10: Stirling Sea Island x Native Buck.
Description.	Ginned and unginned cotton.
Lint:	Clean, fairly soft, lustrous, of deep cream colour and free from stains.
Seeds:	Large chocolate-coloured seed with a tuft of brownish or greenish fuzz at both ends.
Strength.	Fairly good.
Length of fibres.	From 1.4 to 1.9 inch; mostly from 1.6 to 1.8 inch.
Diameter of fibres.	From 0.0005 to 0.0009 inch; average 0.00063 inch.
Microscopical characters.	Normal.
Commercial valuation.	12d. to 13d. per lb., with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

VIII.

Imperial Institute No.	58275-3.
Variety of Cotton.	Hybrid No. 3: Stirling Sea Island x Native Buck.
Description.	Ginned cotton, clean, soft, lustrous, of cream colour and free from stains.
Strength.	Fairly good.
Length of fibres.	From 1.3 to 1.7 inch; mostly from 1.5 to 1.6 inch.
Diameter of fibres.	From 0.0005 to 0.0008 inch; average 0.00063 inch.
Microscopical characters.	Normal.

Commercial valuation.	12d. per lb. with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

IX.

Imperial Institute No.	58275-7.
Variety of Cotton.	Hybrid No. 7: Stirling Sea Island x Native Buck.
Description.	Ginned and unginned cotton.
Lint:	Clean, soft, lustrous, of cream colour and free from stains.
Seeds:	Black, medium-sized seeds, with a small tuft of brownish fuzz at the pointed end.
Strength.	On the whole, fair.
Length of fibres.	From 1.4 to 1.8 inch; mostly from 1.5 to 1.7 inch.
Diameter of fibres.	From 0.0005 to 0.00095 inch; *average 0.00066 inch.*
Microscopical characters.	Normal. A small proportion of immature fibre was present.
Commercial valuation.	12d. per lb. with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

X.

Imperial Institute No.	58275-9.
Variety of Cotton.	Hybrid No. 9: Stirling Sea Island x Native Buck.
Description.	Ginned and unginned cotton.
Lint:	Clean, soft, lustrous cotton, of cream colour and free from stains.
Seeds:	Large chocolate-coloured seeds, with a tuft of brownish or greenish fuzz at one or both ends.
Strength.	Fairly good.
Length of fibres.	From 1.4 to 1.8 inch; mostly from 1.5 to 1.7 inch.
Diameter of fibres.	From 0.0005 to 0.0010 inch; average 0.00066 inch.
Microscopical characters.	Normal.
Commercial valuation.	12d. per lb., with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

XI.

Imperial Institute No.	58275-12.
Variety of Cotton.	Hybrid No. 12: Cross between Native Suwardi cotton and Sea Island x Native Buck hybrid.
Description.	Ginned and unginned cotton.
Lint:	*Clean, soft, lustrous, of cream* colour with a reddish tinge, and free from stains.
Seeds:	Large dark chocolate-coloured seeds, with a small black spike at the pointed end and a tuft of white fuzz at the blunt end.
Strength.	Fairly good.
Length of fibres.	From 1.4 to 1.8 inch; mostly from 1.4 to 1.6 inch.
Diameter of fibres.	From 0.0005 to 0.00085 inch; average 0.00063 inch.
Microscopical characters.	Normal.
Commercial valuation.	12d. per lb., with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

XII.

Imperial Institute No.	58275-2.
Variety of Cotton.	Hybrid No. 2: Stirling Sea Island x Native Buck. average 0.00061 inch.
Description.	*Ginned cotton, clean, soft, and* lustrous, of cream colour and slightly stained.
Strength.	*Fairly good.*
Length of fibres.	From 1.3 to 1.8 inch; mostly from 1.5 to 1.7 inch.
Diameter of fibres.	From 0.0005 to 0.0008 inch; average 0.00064 inch.
Microscopical characters.	Normal.
Commercial valuation.	11d. per lb., with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

XIII.

Imperial Institute No.	58275-13.
Variety of Cotton.	No. 13: Sea Island.

Description.	Ginned cotton, clean, soft, lustrous, of cream colour and almost free from stains.
Strength.	Fair.
Length of fibres.	Irregular, varying from 1.4 to 2.1 inches ; mostly about 1.5 to 1.8 inch.
Diameter of fibres.	From 0·0004 to 0.00075 inch ; average 0.00056 inch.
Microscopical characters.	Normal.
Commercial valuation.	12d. to 13d. per lb., with "best Barbados" at 14½d. and "best St. Kitts" at 16d. to 17d. per lb.

XIV.

Imperial Institute No.	58275-14.
Variety of Cotton.	No. 14: Native Buck.
Description.	Ginned cotton, clean, harsh, fairly lustrous, of cream colour with a reddish-brown tint, and free from stains.
Strength.	Good.
Length of fibres.	From 1.1 to 1.3 inch ; mostly from 1.1 to 1.2 inch.
Diameter of fibres.	From 0.0006 to 0.00105 inch ; average 0·00083 inch.
Microscopical characters.	Normal.
Commercial valuation.	6d. per lb. with "middling" American at 5.32d. per lb.

From the above it will be seen that three of the F_4 hybrids were valued at only ½d. per lb. less than the best Barbados Sea Island.

The work of propagating the hybrids is now receiving attention with a view to improving them by careful selection of seed.

Science After the War.

There is a tendency in the West Indies, like the one in Great Britain, for able young men to neglect science and agriculture as a profession, in preference to Law and Commerce. This war will mean a renaissance of science throughout the Empire ; and if the prospects before a scientific career have in the past been discouraging, there is a great possibility, if all goes well, that in the future the outlook will be a most attractive one.

—"Agricultural News," Barbados, September 11, 1915.

Exports of Agricultural and Forest Products.

Below will be found a list of the Agricultural and Forest Products of the Colony exported this year up to June 30th. The corresponding figures for the three previous years are added for convenience of comparison.

Product	1912.	1913.	1914.	1915
Sugar, tons	21,451	22,349	32,576	42,440
Rum, gallons	1,199,033	1,428,085	1,646,370	2,031,023
Molasses, casks ..	906	575	658	..
Cattle-food, tons ..	2,407	4,690	1,050	979
Cacao, cwts.	102	9	300	284
Citrate of Lime, cwts. ..	43	..	21	70
Coconuts, thousands ..	874	460	1,091	1,064
Copra, cwts.	913	620	820	842
Coffee, cwts.	1,050	647	1,756	678
Kola, Nuts, cwts. ..	..	..	..	2
Rice, tons	2,064	3,338	3,967	5,653
Ricemeal, tons	1,107	1,087	202	206
Cattle, head	314	338	623	307
Hides, No.	1,880	2,421	2,738	864
Pigs, No.	687	942	653	540
Sheep, head	39	18	12	4
Balata, cwts.	316	2,300	3,127	7,568
Charcoal, bags ..	37,825	28,694	36,861	28,236
Firewood, Wallaba, etc., tons	5,290	4,312	5,652	4,442
Gums, lbs.	2,425	1,515	719	..
Lumber, feet	99,550	292,233	198,145	31,619
Railway Sleepers, No. ..	3,876	1,503	2,602	556
Rubber, cwts.	1.3	.7	6	17
Shingles, thousands ..	819	1,269	1,061	1,070
Timber, cubic feet ..	163,261	222,929	132,468	85,807

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